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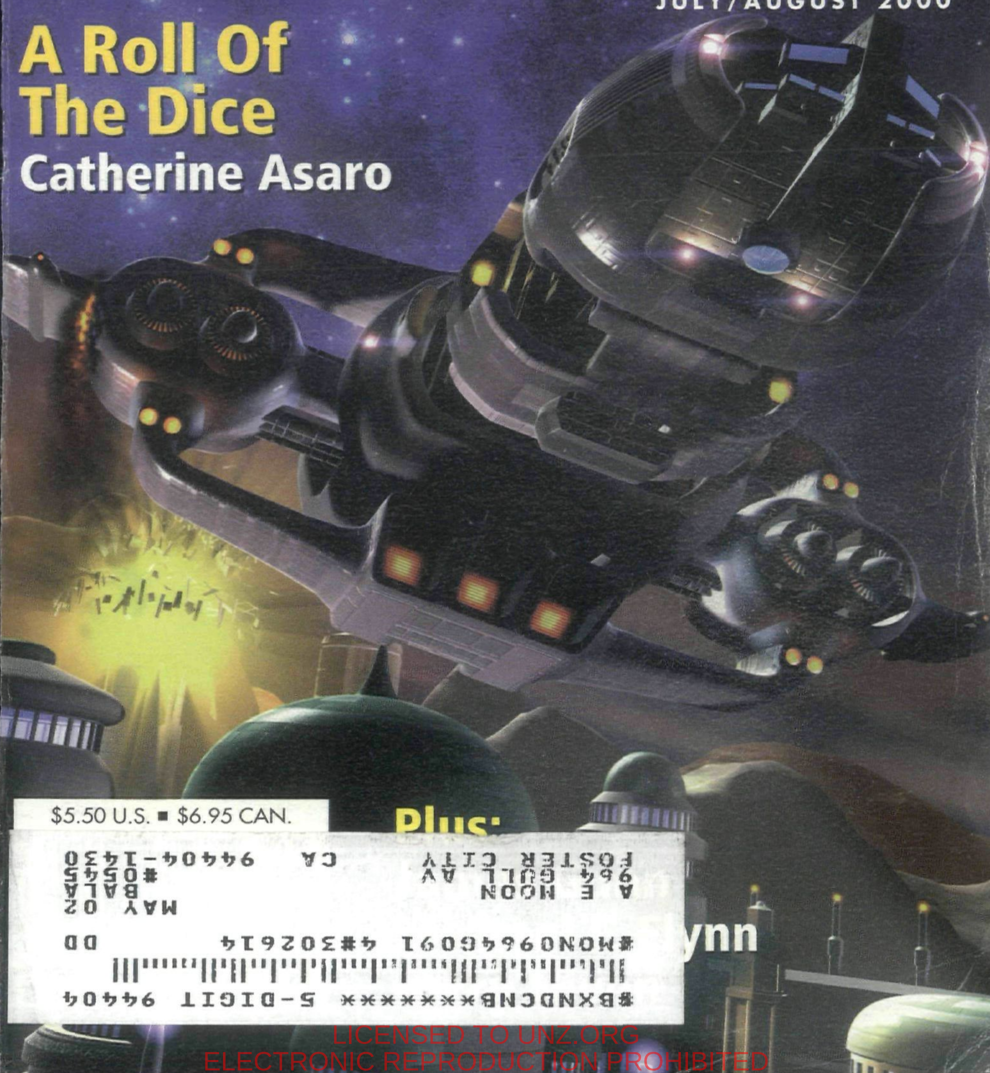

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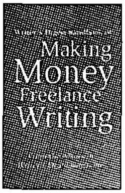
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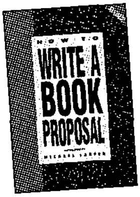
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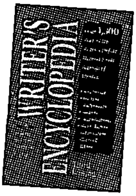
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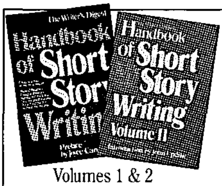
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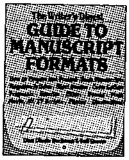
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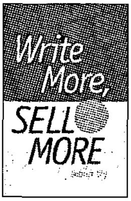
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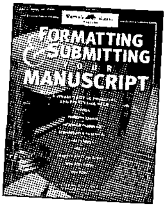
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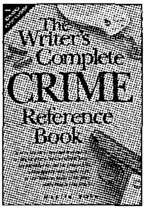
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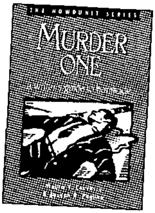
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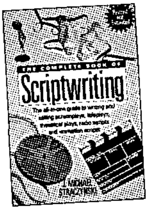
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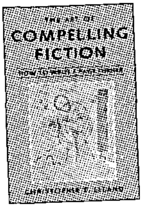
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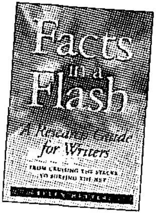
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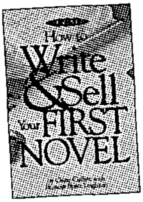
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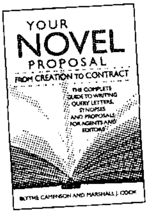
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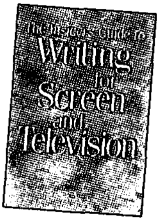
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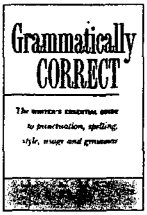
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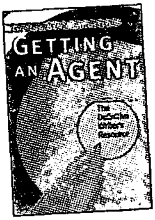
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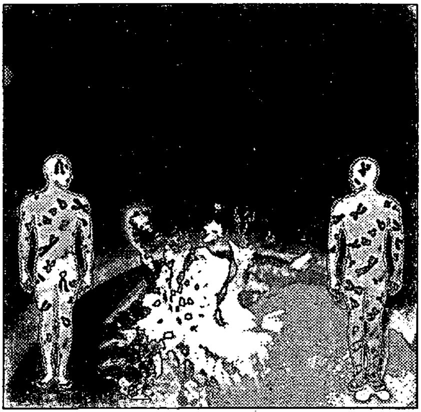

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EDITORIAL Stanley Schmidt

BLUNT INSTRUMENTS

A while back I saw a feature article in a Gannett newspaper on the indisputable trend toward greatly increased use of profanity practically everywhere: in movies, on television, in just about any sort of workplace, even in classrooms and around family dinner tables. In some circles, this trend (like virtually any trend) is Viewed With Alarm, as yet another sign of the end of civility and Civilization As We Know It. Other folks, identified by the article as "experts," see it as a non-problem.

But I submit that they are wrong. The indiscriminate use of profanity *is* a problem, and not just for reasons of morality or civility. It is just one more symptom of a problem that goes far beyond profanity: the reckless dulling of one of the most basic and essential tools of everyday life (which happens, ironically, to include profanity as a subset). The Gannett article did not even mention the larger problem, but that, not profanity *per se,* will be my main concern today.

First, a few words about morality and civility. Profanity really has nothing to do with morality, unless you subscribe to one of the many rather arbitrary codes of conduct floating around, which can and do label virtually *anything* "moral" or "immoral." Over the years I've given a lot of thought to what kind of moral code people can reasonably expect everybody else to follow, without imposing the precepts of anybody's religion on followers of a different one (or none). The only answer I've ever found that seemed logically defensible was that immorality means actions that harm people other than the one doing them.

Profanity doesn't; it is, as one parent quoted in the Gannett article says, "only words." "Bad" words are, in themselves, inconsequential and therefore morally neutral. I once worked with an immigrant who had learned English in places other than the "best schools," whose language was so heavily spiked with swear words that a listener who judged character by vocabulary would have assumed he must be a very wicked man. But he was actually quite a decent sort, and in fact fiercely intolerant of real immorality. You just had to learn to ignore every other word he said to see that.

Civility is another matter. I respectfully submit that it *is* important, and it is endangered. The Gannett article's focus was on the wholesale use of swearing by children, and it quotes Stephen P. Steinberg, identified as executive director of the Penn National Commission on Society, Culture and Community, as saying, "Kids are desperate to talk . . . I don't care if they're rude, crude, or cursing. What is important is that they have a productive conversation."

Well, I do care if people—kids or adults—are rude or crude. Mr. Steinberg's position seems to me uncomfortably close to the assertion that the act of talking is more important than what's being said, which some people actually seem to believe, but which I think is dangerous nonsense. Content *is* important, and so is treating your fellow beings with respect. I fully agree with Mr. Steinberg that kids should be encouraged to talk, and that adults should listen to what they say. But it's perfectly possible, and desirable, to encourage people to express themselves fully and honestly while at the same time insisting that they do so courteously.

Part of the problem that led to Mr. Steinberg's position, I think, is that societies too often confuse courtesy and etiquette, and lock themselves into codes of etiquette so rigid that hardly anyone feels free to speak at all frankly. That *is* a problem—but Mr. Steinberg's response is, in my opinion, an unnecessary and ill-advised overreaction. Etiquette is a formal code of rules whose underlying intent is to ensure that people treat each other with courtesy, even when they're not sure what's appropriate or don't feel like it. Unfortunately, like bureaucracy, etiquette often grows beyond its basic and useful function to prescribe behavior that has nothing to do with courtesy, stigmatizing people for things like using the "wrong" dinner fork or wearing the wrong color socks for the season and hour.

We don't need that kind of etiquette. But we do need courtesy. I certainly don't favor washing kids' mouths out with soap, or fining or jailing adults, because they've used a "bad" word; or even telling anyone they *can't* use certain words. I certainly think a society that conditions its women to faint (literally) at the mention of a body part—as at least one has done—has something wrong with it. But I do favor teaching kids to recognize the difference between courteous and rude behavior toward others, and refusing to tolerate verbal abuse from anyone. I won't and shouldn't try to censor anyone, but I can and will walk away from anyone who can't address me in a civil manner.

Probably most of us have chuckled and/or cringed at recent news stories about local governments dusting off old laws or creating new ones to try to stamp out "dirty words." One in particular—the Michigan man who was arrested for swearing when his canoe capsized—may have made you realize just how absurd such attempts are, even if this weren't "the land of the free." Having capsized a canoe once myself, I can testify confidently that few people in that situation are going to stop to ponder such questions as, "Will I be violating a town ordinance if I say %&!#$?" or "Might I offend some innocent bystander?" Whatever words are going to come will simply come, as fast and reflexively as your hand jerks away when it inadvertently touches a hot plate.

And perhaps they should. Therein lies what I see as the *main* problem in this trend, and the larger one of which it is a part. That Gannett article contains two statements about profanity which are inherently at cross purposes, though neither speaker seems to realize that. A parent unperturbed by her son's frequent profanity dismisses it as, "Just words." But "cursing expert" Timothy Jay says, "You can't express yourself, your emotions, as deeply with other words as with swear words."

Or, as Mark Twain put it, "Under certain desperate and trying circumstances, profanity furnishes a relief denied even

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to prayer."

But *you can't have it both ways.* If these words have a special power to furnish psychological relief under "desperate and trying circumstances," then they are not "just words." But if you use them constantly and indiscriminately under all kinds of circumstances, they soon will be.

With its edge worn off by excessive casual use, profanity ceases to *be* profanity. It becomes just another part of everyday speech and loses any special powers to shock or relieve that it might once have had. This is not idle speculation. Our language has plenty of words that have already suffered this fate, words that were thoroughly shunned as recently as a couple of decades ago but are now commonly heard virtually anywhere and from anyone without raising eyebrows. (I assume I can leave it as an exercise for this audience to supply examples.) And, of course, once that has happened, people who need swear words will have to come up with new ones to replace the ones that have had the edges worn off them. (I'm told that in some circles "stupid" has already achieved the status of "new profanity.")

To those high-minded folk who consider profanity beneath them, and something *they* would never use, this may seem a non-problem. But it *is* a problem, for at least two reasons.

First, almost everybody reads, watches movies or television, or both. Profanity is one of the tools available to the writers of all that material, and it can be quite a powerful one—when used with restraint and care. Strong words have the most impact when used for special occasions, and only for special occasions. I remember reading a novel some twenty years ago (admittedly from an era in which words still had a bit more power to shock), in a climactic moment of which a major character simply thought a single word that he would never have used anywhere else in the book. Those four little letters, under those circumstances, conveyed as powerfully and eloquently as anything could just how much stress he was under. They would have had no emotional impact at all if he had been using that same word in every other paragraph throughout the book.

It's a definite and important step forward that it's no longer a major news event when somebody gets a single "damn" past the movie censors. But many contemporary writers remind me of children who have suddenly had an

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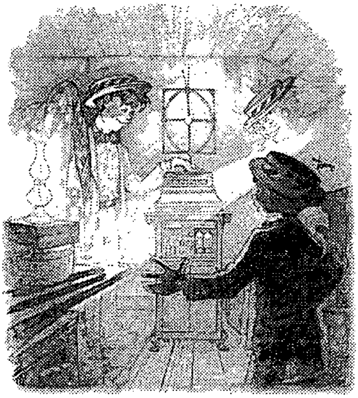

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old restriction removed, and now feel the need to flaunt their newfound freedom incessantly. Unfortunately, in the process they often rob themselves of a powerful tool of their trade.

The other reason such dulling of linguistic tools should concern everybody is that profanity is by no means the only one it can happen to. *Any* word with great strength or precision will lose that strength or precision if used too often and indiscriminately. When "awesome" becomes a routine term of even mild approval, applied a dozen times a day to things like the taste of a new candy or a website with cute graphics, what are you going to say if you ever encounter anything that really *is* awesome? If you're lucky, you might, a few times in a lifetime—something like a close-up view of a Saturn V launch, or a total solar eclipse under optimum viewing conditions, or a first-rate performance of Mahler's "Resurrection" Symphony. Words like "awesome" were coined expressly to describe such rare experiences. How will you describe them when you've worn out those words and thrown them away on the commonplace?

Have you noticed that hardly anybody ever says "problem" any more? Everything is now an "issue"—perhaps because "problem" implies the need (and possibility) of a solution, while "issues" just need to be "addressed" (whatever that means).

And it isn't just *words* that need strong, sharp edges, subject to dulling through excessive, careless, or inappropriate use. In reading thousands of manuscripts over the last couple of decades, I've often been struck by how many people use or omit punctuation in an almost random fashion. This tendency, too, may be increasing; and to the extent that it is, much of the blame seems to fall squarely on precisely those people who should have been preventing it: English teachers.

I once commented to a promising new writer (with impressive educational credentials) that her manuscript should have contained a lot more commas than it did. I was appalled when she said she figured she could put them back in, but for years her teachers had been encouraging her to leave them out. Apparently the prevalent reasoning in some circles has been that it might bruise students' precious egos to claim that some ways of punctuation are better than others.

But some ways of punctuation *are* better than others! Our language has spent centuries developing a system of punctuation that can insure unambiguous communication by clearly marking the difference between similar combinations of words with dissimilar meanings. Helping students to understand and use that system *empowers* them; shirking the job to coddle their egos, if pursued to extremes, weakens them and has the potential to dissolve communication into a vague haze.

And the shades of meaning distinguished only by punctuation are not necessarily trivial. They can be of literally life-or-death importance. Do you want anything in your life dictated by orders written and read by people who see no difference between, "Shoot, John" and "Shoot John"? If you think hyphens in the phrase "thirty seven year old majors" are optional, I suggest you draw little pictures to help you visualize the difference between "thirty-seven-year-old majors," "thirty seven-year-old majors," and "thirty-seven year-old majors"—and think about the potential consequences of each.

The elements of language are some of the most important, versatile, essential tools we have. But they can't work to capacity unless they are maintained and used appropriately and precisely. That means using exactly the right ones whenever they are appropriate, and not flinging them around haphazardly when they are not. And that applies equally to *all* linguistic tools—including, but by no means restricted to, $#@&*%! ■

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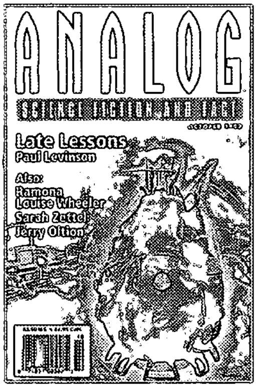
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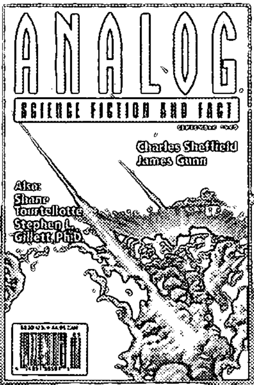
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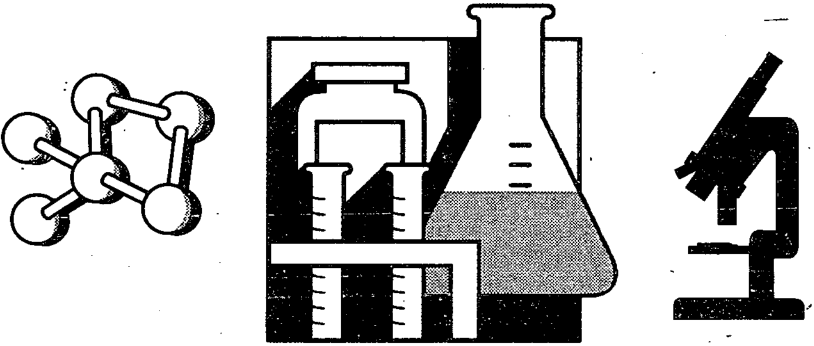

Our sincere thanks to all of you who voted in our annual poll on the previous year's issues—your most meaningful form of positive reinforcement for the authors and artists who do an especially good job of entertaining you. Your votes help your favorite writers and artists by rewarding them directly and concretely for outstanding work. They help *you* by giving us a better feel for what you like and don't like—which helps us know what to offer you in the future.

We have five categories: novellas, novelettes, short stories, fact articles, and covers. (No vote for serials because there are too few of them.) In each category, we asked you to list your three favorite items, in descending order of preference. Each first place vote counts as three points, second place two, and third place one. The total number of points for each item is divided by the maximum it *could* have received (if everyone had ranked it #1) and multiplied by 10. The result is the score listed below, on a scale of 0 (nobody voted for it) to 10 (everybody ranked it first). In practice, scores run lower in categories with many entries than in those with only a few. For comparison, the number in parentheses at the head of each category is the score every item would have received had all been equally popular.

NOVELLAS (2.22)

1. "The Astronaut from Wyoming," Adam-Troy Castro & Jerry Oltion (5.37)
2. "Twenty-one, Counting Up," Harry Turtledove (2.77)
3. "Reality Check," Michael A. Burstein (2.18)
4. "Elephants' Graveyard," David Alexander and Hayford Peirce (1.96)
5. "The Trees of Verità," Wolf Read (1.65)

NOVELETTES (0.71)
1. "The Giftie," James Gunn (1.53)
2. "As Time Goes By," Amy Bechtel (1.43)
3. "Emperor Penguins," F. Alexander Brejcha (1.19)
4. "Vultures," Stephen L. Burns (1.16)
5. "McAndrew and the Fifth Commandment," Charles Sheffield (1.05)

SHORT STORIES (0.67)
1. "Democritus' Violin," G. David Nordley (2.16)
2. "Nor a Lender Be," James Van Pelt (1.28)
3. "Ark Ascension," James Van Pelt (1.17)
4. "You May Already Be a Winner," Stephen L. Burns (1.10)
5. "The Dashing About Flying Box People," Uncle River (1.06)

FACT ARTICLES (1.82)
1. (tie) "Planets X," Stephen L. Gillett, Ph.D. (2.52)
"Beamriders," G. David Nordley (2.52)
2. "Unresources," Stephen L. Gillett, Ph.D. (1.98)
3. "Diamond Ether, Nanotechnology—and Venus," Stephen L. Gillett, Ph.D. (1.94)
4. "Tricorders, Yactograms, and the Future of Analytical Chemistry," Richard A. Lovett (1.82)

COVERS (1.82)
1. December (for "Heat"): Ron Miller (2.63)
2. (tie) March: George H. Krauter (2.39)
July/August (for "The Astronaut from Wyoming): Nicholas Jainschigg (2.39)
3. November: Kim Poor (2.06)
4. September: Kim Poor (1.98)

All categories had clear first-place winners this year, one of them, "The Astronaut from Wyoming," achieving one of the highest scores and strongest leads we've ever seen. We had one first-place tie, in Science Fact, and one author, Stephen L. Gillett, Ph.D., who took three of the top four spots in the same category. The novella voting suggests that most of you enjoyed Harry Turtledove's "mirror novella" experiment, though a very few of you (mistakenly) thought we were trying to coerce you to buy an extra magazine.

As always, since Anlab votes are so useful to everyone concerned, we hope to get even more votes next year. Use e-mail or "snail mail," whichever you prefer, but please vote! (And please be careful to vote in the right category, as listed in the annual Index. Every year a few votes are wasted by being cast in the wrong category, and those simply can't be counted. If you didn't use the online voting on our website this year, you might want to try it next time; it makes that problem virtually impossible!)

Ryan Crain, of Duluth, Minnesota, is this year's winner of a free one-year subscription in a random drawing from all ballots received. Next year that could be you—and the more votes we have, the more the results mean!

A Roll of the Dice

Catherine Asaro

In research, there's no substitute for field experience—but there can be too much of a good thing!

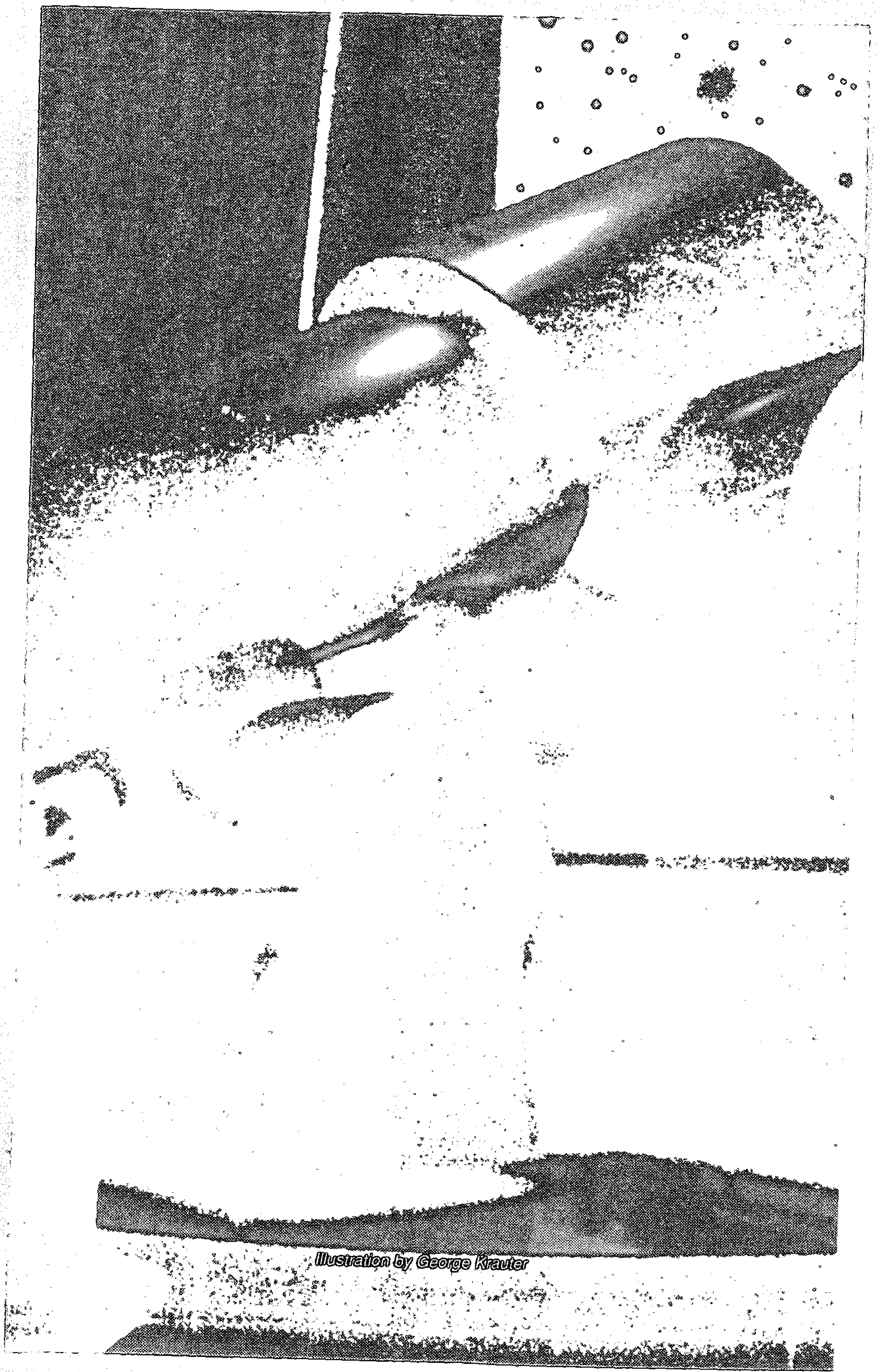

Illustration by George Krauter

I
Quis Web

Jeremiah's kidnappers let him watch the delegation that came to negotiate on his behalf. The wall in front of him was one-way glassplex; he could see the people in the room beyond, but to them the wall appeared opaque.

He didn't recognize the man speaking, but the fellow wore the uniform of the Foreign Affairs Corps for the Allied Worlds of Earth. Jeremiah knew the other two people in the delegation: Deborah Svenson, Dean of the Graduate School of Arts and Sciences at Harvard, and Professor Jack Brenn, Jeremiah's thesis advisor in the anthropology department.

One of Jeremiah's kidnappers also stood in the room: Chankah Dahl. As Manager of Dahl, she governed one of the largest city-states in the human settlement on the planet Coba. A tall woman with gray hair, she ranked high in the power hierarchy of the Twelve Estates.

The voice of the Foreign Affairs officer came over an audiocom set high in the wall. "You must understand, Manager Dahl," he continued. "Jeremiah Coltman is a citizen of the Allied Worlds. Your decision to send him to another Estate against his will is considered abduction by our people."

Manager Dahl remained unperturbed. "You are well aware that before Jeremiah came here, he signed an agreement to abide by our laws." She looked around at them. "Your government has no jurisdiction here. He is ours now."

Jack Brenn stiffened. A large man with broad shoulders and a shock of black hair, his intensity almost crackled in the room. "You have no right to hijack him this way! He signed that agreement with the understanding that it meant you could *deport* him if you didn't like him."

"But we do like him," Chankah said mildly. "We have bestowed our highest honor on him."

Dean Svenson spoke. "Now that Jeremiah's fieldwork is complete, he wishes to return home. Manager Dahl, he has his school, work, relatives." Quietly she said, "His life."

The Manager said, simply, "He is Calani. Calani do not leave Coba."

Jeremiah touched the engraved band that circled his biceps. He had one on each arm. Made from solid gold, they symbolized his position. Calani. Dice player.

He really, really didn't want the honor.

"I will relay your regards to him," Chankah finished.

Jeremiah recognized her tone. She was dismissing the delegation. He hit his fist on the glassplex. "I'm here!" he shouted. He knew it wouldn't carry through the soundproofed wall, but he had to try. "Don't go!"

Only his silent reflection answered. He regarded it, seeing a man more of Coba than of Earth. Three years ago, when he arrived in Dahl, he had been soft, out of shape, plump. Now lean muscles replaced the flab, built by his job on the construction crew where he had worked until ten days ago. He would never be tall or husky, but he enjoyed a fitness now he had never known before. He loved working in the crisp air of the spectacular Teotec Mountains. During the day he labored with his muscles and at night he labored with his mind, writing his dissertation. His only "hardships" were the lack of computers and the relatively low level of technology here, where the culture had backslid. He had otherwise thoroughly enjoyed his life.

Until now.

Instead of comfortable work clothes, today he wore garb appropriate for a Calani: rich suede trousers, a suede vest, and a white shirt embroidered at the cuffs with threads made from gold. His armbands went over the shirt sleeves and heavy gold guards circled his wrists. His hair spilled over his ears and down his neck in tousled brown curls.

Behind him, the lock mechanism on the door clicked. He turned to see a woman enter with an octet of guards. She riveted attention. At six-foot-two, she stood six inches taller than him. Her face showed the classic beauty of Coba's highborn. She was almost twenty years his senior, just past forty, but she had the build and vibrant health of an athlete half her age. Her suede trousers clung to her long, muscular legs. A trace of silver dusted the tendrils of hair that curled at her temples, and a heavy auburn braid fell down her back to her waist. Her eyes, large and gray, had a luminous quality. Her simple clothes had no adornment and needed none: her aura of authority drew notice far more than any jewelry or bright colors.

Jeremiah knew little more about her than her name. Khal Viasa. As Manager of Viasa, she governed a small but wealthy city-state high in the mountains. During his years here, he had seen her only at a distance when she visited Dahl. He hadn't thought much about it, though he had always noticed her striking appearance. No one would ever describe Khal Viasa as "pretty." Elegant perhaps, mesmerizing, stunning, regal. It had never occurred to him that so powerful a ruler would notice a simple laborer. Nor had he expected his reputation as a good Quis player to carry beyond Dahl.

Ten days ago Manager Dahl told him the news; Manager Viasa had bought his Calani contract—a contract he hadn't even known he owned. They seemed to find this a perfectly reasonable transaction, despite his incredulous protests.

Be careful what you wish for. If ever a situation had earned that warning, this was it. He had wanted a chance to observe the Calanya, the elite group of dice players that lived on a Manager's Estate. He considered his inability to study that cloistered institution a weak point in his dissertation. Calani played the strategy game of Quis. They studied for years and had to pass rigorous exams before they could apply for positions within the Calanya of the Twelve Estates. Well, he hadn't applied for anything. If he had known his talent would lead him into this situation, he would never have let anyone find out how well he took to the game.

Manager Viasa came over to him, moving with a natural grace. She spoke in the Teotecan language. "My greetings."

"They're leaving." Jeremiah motioned to the room beyond the glass. "Without me."

She put her hands on his shoulders, making him acutely aware of both her greater height and her sensuality. "Surely you know better than to speak in front of your escort. Manager Dahl told me that you spent the last tenday learning the ways of the Calanya."

Learning? Is that what they called it? He had spent the last ten days in a guarded suite, albeit one far more luxurious than the apartment where he had lived before. Yes, Manager Dahl had given him the Oath: never again read, write, or speak to anyone outside the Calanya. He couldn't live that way. Scholarship was his life. When he broke the Oath, however, they put him in solitary, which he hated. So for now he remained silent.

His thoughts must have shown on his face. Khal's voice gentled. "Jeremiah, I realize you are unhappy with this. I am sorry it is hard for you. I hope you will feel better when we reach Viasa. We leave tonight."

That only made it worse. In Viasa, his chances of escape went to nil.

Starlight silvered the towers of Viasa as the windrider descended in the night. The Estate rose out of the darkness like an ancient castle. The old fortress now served as the headquarters and home of Manager Viasa and her staff. A wall surrounded the Estate and city. Sharply slanted roofs came into view, their stark beauty accented by lights within arched windows. Mist wreathed Viasa, turning the lights a hazy gold and curling around shadowed arches and spires. Beyond the city, jagged mountains stepped up into the sky.

Viasa stood near Grayrock Falls, high in the Teotec Mountains. Jeremiah knew that even if he did somehow escape his guards, no feasible way existed to leave here except by air. He had never flown a rider, and the winds that ripped through these upper ranges were inimical to all but the most seasoned pilots. Even with equipment, supplies, and luck he doubted he could survive the months-long hike out of the mountains and across the desert to the starport.

He wondered if the delegation knew he had left Dahl. Would they go home without him? The Allied authorities had warned him that if he insisted on coming to Coba, he would lose their protection. The human settlements that had spread across the stars were splintered into three political entities. The Allied Worlds of Earth existed in the shadow of two giants, the Skolian Imperialate and the Trader empire. The Skolians claimed Coba. Earth had no wish to strain its precarious relations with the powerful, warlike Skolians, particularly not for a graduate student who, in the greater scheme of things, had little consequence.

The wings of the windrider spread in metal pinions. Painted to resemble an althawk, the craft rode the gales like a giant bird. It soared over the city rooftops and landed on an airfield lit by misty lights.

Jeremiah looked around the cabin. It seated ten: his guards, Khal Viasa, and himself. The pilot and co-pilot sat up front. As he undid his safety harness, his guards rose to their feet. All eight women were taller than him, as were most Cobans, both male and female. These wore dusky purple uniforms with the Viasa symbol on their shoulders, a stylized image of Grayrock Falls. Stunners hung on their belts, guns that fired needles with a fast-acting sedative.

The captain opened the hatch. Accompanied by six guards, Jeremiah jumped down onto the tarmac. As he pulled his fur-lined hood tighter against the tearing gales, Khal stepped down with the other guards. Her hood framed her face, making her large eyes even more intense. She smiled slightly at him, as reserved as always, but also with discreet surprise, as if she too found it astonishing that he was her Calani.

The icy wind at Viasa made even the gales at Dahl seem like puffs of breeze. Leaning into the rushing air, they ran across the tarmac to the Estate and entered the fortress through a graceful quartz arch in its stone wall. Relief washed over him as they reached the protection of a vaulted hall.

Several Estate aides waited for them. As they bowed to Manager Viasa, they darted glances to where Jeremiah stood with his escort. He seemed to intrigue them just as much as his rare glimpses of a Calani in Dahl had fascinated him.

A dark-haired woman spoke. "Welcome back, Manager Viasa."

"I came as soon as I received your message," Khal said. "What is the situation at the dam now?"

Her aide looked worn out, with dark circles under her eyes. "The electrical plant still isn't functioning. The beacon that guides windriders in the mountains has already failed. If this continues much longer, neither Viasa nor Tehnsa will have power."

Jeremiah tensed. No wonder Khal had wanted to return so soon. The Viasa-Tehnsa Dam harnessed energy from the Grayrock Falls. In this remote mountain region, it provided the only continuous source of power for Viasa, and also for Tehnsa, its dependent city-state.

Khal came over to him. She stood a fraction closer than he expected, nothing that would have been unusual in Cambridge on Earth, but a bit off-kilter here, given the famous reserve of the Viasa people. She spoke in her husky con-

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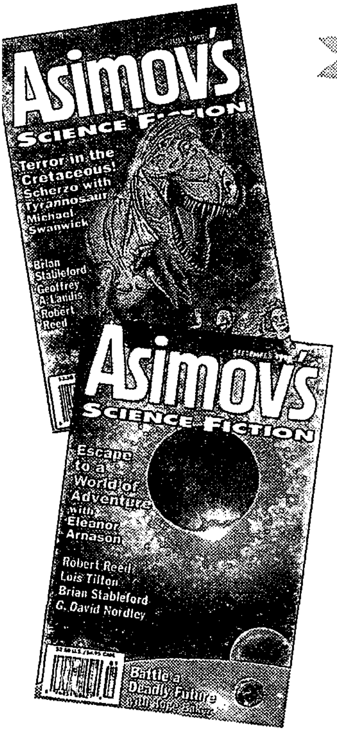
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tralto. "I'm sorry, Jeremiah. It seems Viasa demands my attention. Your escort will show you to your rooms."

He nodded, relieved. Tired and disheartened, he needed to withdraw into privacy.

Khal spoke to the captain of his escort. "Take him into his suite by the private door. The others can wait until later to meet him." She smiled at Jeremiah—and it changed her entire face. Instead of classic reserved perfection, she suddenly became warm and vibrant. "The other Calani are curious about you. None have ever even seen an offworlder, let alone met one."

He just nodded again, glad he didn't have to think of a response. She brushed his arm in an unexpected touch of farewell. Then his guards escorted him out of the hall. They followed marble corridors with high, arched ceilings. At first he thought the bronze claws on the walls held torches; then he realized they were electric lights. The lamps resembled flame, adding to the ancient atmosphere, a reminder of Viasa's age and conservative nature.

The next wing they entered, however, had genuine torches in the claws. They stopped at a wall engraved with arabesque designs. When the captain pressed a series of ridges in the design, clinks came from within the wall. She leaned against the stone and a door swung inward. Moving to the side, she bowed to Jeremiah. He looked back at her, puzzled. Then he realized she was waiting for him to enter.

He walked into a suite of stunning luxury. The darkwood furniture gleamed with red highlights. Pale green cushions lay on divans and in piles on a plush gold rug. The walls were painted dark amber near the floor, then shaded upward through lighter golds and into ivory near the ceiling. Held by slender gold chains, lamps hung from the ceiling, spheres of delicate frosted glass hand-painted with mountain scenes. Blown glass vases graced the tables, each with a blue-green stalk topped by a spray of gold spheres the size of marbles, but airy and hollow.

The bathroom alone was as big as his old apartment in Dahl. A pool filled most of it, fed by fountains and tiled in green, with frothy jeweled inlays. The bedroom had a canopied bed made up in blue and green velvet. Copper braziers kept the room warm. In the window seat, starlight streamed through tall panels made from unbreakable glassplex. Looking through the windows, he realized the outside wall was a sheer cliff face that plunged far down into the mountains.

When they returned to the living room, the captain indicated a horseshoe arch set across from the private door. Gold mosaics bordered the arch and ivory drapes hung within it. "That leads to the main common room for all the suites," she said. Then she bowed to him. "We will leave you to rest. If you need anything, we will be Outside."

He nodded, knowing full well the real reason they were posted around his suite. Khal meant to ensure he stayed put.

When Jeremiah was alone, he sunk onto a divan, too tired even to go to bed. After awhile, a tap came at the archway to the common room. He wanted to ignore it, but the same inexhaustible curiosity that had spurred him to become an anthropologist got the better of him now.

"Come in," he said.

The hangings shifted to reveal a tall man with a husky build and broad shoulders. He looked about forty, with the classic features of the Coban highborn. Gray dusted his black curls. He stood with natural confidence, as if he took his high status for granted. His clothes resembled Jeremiah's, but darker in color. Three bands circled each of his arms, rather than one. Jeremiah wondered why he rated more, then felt irked at himself for caring.

"My greetings," the man said. "I am

Kev." He took in Jeremiah's slouched posture. "I can return another time, if you prefer."

Although Jeremiah didn't feel like company, he had no wish to alienate the other dice players. He would be living with them for some time, maybe even the rest of his life, a possibility he was doing his best to forget.

He sat up straighter. "Come in. Please." He indicated an armchair set across a table from him. "Be comfortable."

Kev settled into the chair and stretched his long legs across the carpet. "Being Outside is tiring. But you need not worry. You will not have to go there often."

"Outside?"

Kev gestured around them. "The Calanya, the place where we live, is Inside. All else is Outside."

Jeremiah stared at him. "We never leave these suites?"

"We have this wing of the Estate. And the parks. They cover twenty square kilometers." Kev looked apologetic. "Most Calanya have more land. These mountains limit Viasa's space. Still, it is enough, I think, for fourteen people."

"Fourteen Calani live here?"

"Counting yourself."

Jeremiah rubbed his eyes. "Don't remind me."

Kev considered him. "The rumors are true, then? You received your Oath against your will."

"Yes."

"It is hard to imagine. Many people would give much to be where you are now."

Jeremiah shook his head. "I had no idea Manager Viasa wanted my contract."

"Normally the Calani decides what offer to accept," Kev acknowledged. "When Khal initiated the negotiations for your contract, news of your Quis talent spread. Several Estates entered the bidding despite your lack of formal study."

Jeremiah stared at him. *Other* Managers had also bid for this clandestine dice contract of his? "How do you know?"

Kev's expression turned inscrutable. "Khal and I talk."

Khal. Kev spoke as if it were natural to call one of Coba's most powerful leaders by her first name. Calani were among the elite who might address a Manager in such a manner. Jeremiah couldn't imagine doing so, no more than he had ever felt comfortable using "Jack" for Professor Brenn, even after Brenn insisted. Maybe the ease came with experience.

"How long have you been a Calani?" Jeremiah asked.

Arrogance touched Kev's voice. "Twenty-three years. I took the Oath at sixteen."

That boggled Jeremiah. Kev must have spent most of his life in seclusion, playing dice. Then a thought came to him: *Is it really so different from the way I've studied all my life?* He might as well have been in seclusion given how rarely he ventured out of the library or classroom.

Yes, he thought. *It's different.* He had chosen that life, rather than having it chosen for him.

Jeremiah slept through the morning, something he rarely did on Coba, given its thirty-two-hour days. He didn't feel like getting out of bed. He spent the afternoon in his robe, sitting in the window seat of his bedroom, staring out at the chasm of air and the drifting clouds below.

Of course he tried to leave. He heaved open his private door and found guards Outside, all armed. When the captain asked if they could do anything for him, he shook his head and closed the door. Then he returned to the window seat and watched the sky.

In the evening, he roused himself enough to bathe in his swimming pool with its fountains. He shaved using a pearl-handled razor he discovered laid out with a towel on a polished stone bench by the pool. Back in his bedroom, he changed into clothes he found in the wardrobe, garb similar to what he had worn yesterday. Then he sat by the window again.

Kev came to ask if he wanted to join the other Calani for dinner in the common room, or would he like his meal here. Jeremiah shook his head to both suggestions.

Finally night settled over the cliffs. He was still sitting by the window when the guards came for him.

Blue and green mosaics tiled the halls, with gold accents that gleamed in the torchlight. After following a maze of corridors, the guards took him up a tower, climbing a spiral staircase of black marble. No one explained why or spoke to him.

At the top, they came to a horseshoe arch. The suite beyond was even more refined than his own. Soft light diffused from panels in the ceiling. Parchments on the walls glimmered with paintings of birds and branches. Dark urns as tall as Jeremiah stood in the corners, enameled with clusters of gold marble-flowers.

His escort showed him into a room with blue-shaded walls and a pale blue rug. It had no furnishings, only a voluptuous pile of green, blue, and gold pillows heaped in one corner. The captain bowed to him and then the guards withdrew. A moment later Jeremiah heard the door close, followed by the click of the lock mechanism.

He rubbed his chin, baffled. What did they expect him to do here? For a while he paced the rooms. When he grew tired of looking for a way out, he lay among the pillows, letting their softness envelop him. With no other outlet, he sought the freedom of sleep.

Sleep, however, evaded him. Instead, tears slid down his face. Damn. He hated to cry. The tears came anyway, for the loss of his freedom and the people he loved. After a while he did manage to drowse, but he never fully slept.

"Jeremiah?"

He opened his eyes. Khal Viasa was standing above him, dressed in a clinging robe of red velvet. She had unbraided her hair, and it fell in glorious auburn waves to her waist. He stared at her, bewildered, aware of her long, lean curves under the robe.

She knelt next to him among the pillows. "Your guards told me you haven't eaten all day."

"I wasn't hungry." He rubbed his palm across his cheek, trying to erase the signs of his tears.

"Ai, Jeremiah," she murmured. "I am so sorry you are unhappy."

Her compassion caught him off guard. He had expected her to be as cold as everyone else he had met from Viasa. Maybe under that infamous reserve, they were human after all. "I don't understand what you want from me."

"To eat. You will become sick if you refuse food."

He wanted to say no. His diet was tricky, though. He had none of the immunities that protected Cobans against the poisons and bacteria here. It limited the foods he could eat, and his water had to be treated. One reason he had lost weight so fast when he first came to Coba was because he had been sick so much, until he and his doctor worked out a diet he could tolerate. If he became careless now, he risked upsetting the chemical balance his body needed to maintain.

After a pause, he said, "All right."

Khal rose to her feet and went to an audiocom in the wall. When she touched its fingertip panel, a woman's voice floated into the air. "Seva here."

"Seva, this is Manager Viasa. Have the instructions for what Jeremiah can eat and drink been given to the kitchens?"

"Yes, ma'am. Last night, right after you landed."

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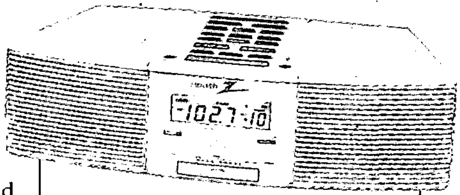

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"Good. Have dinner brought up for him and me. We missed the evening meal."

"Right away, ma'am."

Jeremiah wondered why she hadn't eaten. She looked exhausted. "Are you all right?" he asked.

She came back and settled next to him in the pillows. "I am fine. But it is kind of you to ask."

"Is it the Viasa-Tehnsa dam?"

Khal sighed. "It took all day to repair the electrical plant. The beacon still doesn't work. Then I had to explain to Manager Tehnsa why it all failed." She gave him a look of apology. "But I shouldn't bore you with mundane Estate details."

"It's all right." He preferred mundane details to thinking about his situation.

The audiocom buzzed. Then a girl said, "Your meal is here, Manager Viasa."

"Ah. Good." Khal rose gracefully to her feet and left the room. She returned with two junior aides. The boy carried a gold platter with an ornate cover, and the girl had a blue lacquered stand trimmed with gold and pearl inlays. They bowed to Jeremiah, set up the stand with the platter, and then withdrew from the room. A moment later the door closed and locked.

Jeremiah blinked. "That was fast."

Khal smiled. When she lifted the cover off the platter, an aroma of spices filled the room. It made his mouth water. Maybe he was hungry after all.

Dinner was set out on the platter. Khal filled two gold-rimmed crystal goblets with red wine and gave him one. Then she took a plate of spiced meatballs and settled next to him among the pillows. Using a small gold fork, she speared a spice ball and offered it to him.

Jeremiah flushed. He would never have expected an Estate Manager to feed him. Self-conscious, he ate the spice ball. It tasted even better than it smelled, and he suddenly realized he was famished.

She gave him another, then speared one for herself. They alternated eating spice balls with drinking wine, Khal feeding them both until they finished the plate.

He took a last swallow of wine. "That was good."

"I am glad you liked it." She finished her drink, then took his empty goblet and set it with hers on the rug.

Jeremiah lay back in the pillows, relaxed now. Tipsy, in fact. Khal leaned on her elbow next to him, an intimacy that made him even more aware of her presence. The collar of her robe slipped down her shoulder, revealing smooth skin. He didn't think she noticed, but that only made the effect more erotic. She nudged him onto his back and began to unlace the thongs that held his shirt closed.

Jeremiah caught her hand, still sober enough to read the implications under her seduction. "What are you doing?"

Her eyes were glossy from wine. She disengaged her hand from his and tweaked open his shirt. Then she slid her palm across his chest. "You are very beautiful, Jeremiah."

Beautiful? Right. What was going on, with a private den, an intimate feeding, and now this? On Earth, women had never noticed him. It hadn't surprised him, given how he saw himself: a fat, short, boring nerd. His parents claimed his negative self-image was undeserved, that it came from taunts he had taken as a boy, when in truth he was "a charming, intelligent young man." Well, of course they said that. They were his parents. They would think he was charming if he fell on his face in the mud.

It was true, though, that in Dahl his shyness had become an asset. Coban women valued the trait in men. But he had never risked having a girlfriend there. The Twelve Estates operated on a double standard that could have come from the Dark Ages, except here it applied to men. A woman could do as she pleased, but a man was expected to behave with decorum. Had he taken a lover, Manager Dahl would probably have asked him to leave. In a place as conservative as Viasa, he could have been deported.

In some ways, it had been fun. Women in Dahl considered him a challenge, an exotic treat they were convinced wanted his honor compromised. After all, he came from offworld. Surely if a single young man traveled so freely, without a chaperone, he must be free in other ways too. But even the most aggressive had never pushed this hard. The implied insult in Khal's behavior stunned him. It also hurt, given his attraction to her, but he didn't want her to know.

She touched his cheek. "Your emotions flash across your face like a beacon. Why are you upset?"

He spoke coolly. "It's obvious why you had me brought here."

"I should hope so." She smiled. "This is the Akasi suite."

Akasi? Oh, Lord. *Oh, Lord.*

She was watching his face. "You didn't realize?"

"No." He flushed. "I hardly *know* you."

Khal looked at a loss for words. "Chankah Dahl led me to believe that you knew of my proposal."

He thought back. Yes, the Dahl Manager had said something about an Akasi during his solitary confinement. He had been so angry at the time, he had refused to listen. "I . . . missed it."

"It is a big thing to miss."

No kidding. Akasi Calani. How could he be married to this stranger? "When did we, uh, have the ceremony?"

"We were wed as soon as you signed the Calanya contract."

"I didn't sign anything. Manager Dahl wrote my name."

"Well, yes, it did work out that way," Khal admitted. She brushed her knuckles over his cheek. "I won't hurt you, sweet Jeremiah." Then she went back to unlacing his shirt.

Flustered, he caught her hand. "Now wait a minute, Manager Viasa."

"Khal," she murmured.

He reddened. "Um, okay. Khal."

"It is all right," she soothed. "Try to relax." She slipped her hand free, then finished undoing the buttons that closed the outer seams of his sleeves. As she tugged his shirt away from his body, her robe slipped more, revealing tantalizing hints of skin.

This all felt surreal, like a dream. Real or not, though, it was a marked improvement over the last few days. With a sigh, he let go of his resistance and put his arms around her waist. Drawing her close, he inhaled her scent, a fragrant blend of spices and incense.

Khal reached down to the outer seams of his trousers, which were held closed by flaps. As she undid the flaps, she traced her fingertips over his skin. He finally understood why men's trousers here had such an odd design. A woman who knew what she was doing could make taking them off intensely erotic.

Pushing up on her elbow, Khal gazed at him. "You've such big eyes." She rolled a lock of his hair between her fingers. "Our poets write soliloquies about the wind god Khozaar. They say his face has a beauty no mortal man can match. But they never saw yours, Jeremiah. You shame even the wind."

Good Lord. She was sweet-talking him. Before he could think of an appropriate response, if one even existed to such outrageous statements, she added, "I can't believe the women on your Earth let you come here alone."

"Oh, well. You know. I had them all dazzled." He had to laugh. "They never even knew I *existed.*"

"You are modest. I like that." She brushed her lips across his cheek.

He pulled her closer, pressing his cheek against hers in a gesture his one and only girlfriend on Earth had called "too tender," as if that somehow made it wrong. Khal seemed to like it, though, which pleased him.

Had her clothes been made with the same complicated flaps and fastenings as his, he doubted he could have figured them out in his inebriated state. But it was simple to pull the braided cord of her robe and slip the velvet off her body. She wore a silk shift underneath that rippled over her toned curves. He watched with appreciation when she sat up and pulled the shift over her head, her breasts lifting as she raised her arms. The silk trailed over her nipples. He wondered if all Coban women were so well-formed, or if she took unusually good care of herself.

She settled alongside him and touched her lips to his, but she resisted when he tried to pull her into a kiss. He hesitated, unsure if Cobans had the custom. He had never seen two Cobans kiss, and his questions had always been met with embarrassed silence or smirks. If they did kiss here, they considered it far more private than in the Wyoming culture on Earth that had produced him.

Uncertain what Khal wanted, he stopped trying to push. It seemed the right response; she relaxed and brushed her mouth over his again, feather light. She slid down and touched her lips to his chest, her caress maddening in its "almost there" quality, as if she would stop teasing any moment and truly kiss him. He tried to reach for her, but she nudged him back in the pillows. Then she tickled his belly button with her tongue. Jeremiah laughed and stroked her hair, staring at the gold ceiling.

When she went lower still, he couldn't take any more. Grasping her arms, he tugged her back up and rolled her over until he lay on top of her. She made a deep-throated sound, a blend of surprise, protest, and pleasure. Caressing her breasts, he tried to kiss her again. This time she turned her head.

"Come on, Khal," he said against her ear.

She pressed her hands against his shoulders, pushing him over onto his back again. Disconcerted, he realized that with her muscled body and greater height, she was stronger than him. She didn't want to fight, though. When he relaxed, she touched him all over with both her mouth and hands, taking her time, until he groaned. When he tried to return her caresses, she always nudged him back into the pillows.

Finally he grasped her shoulders and dragged her up on top of him. "Quit teasing me," he said in a husky voice. "You're making me crazy."

Her eyes had glazed with desire. "I always wondered, when I saw you in Dahl, what passions lay under that ice prince exterior of yours. Rumor said no woman could melt the ice, but I knew they were wrong."

The women in Dahl had talked about him? Then again, what did it matter now? He tried to kiss her again—and this time she responded, deep and full. As he stroked her, she moved her hands on him. Then she lifted her hips and slid down, filling herself with him. They made love buried in the pillows, slow and steady. When he finally climaxed, she let herself go as well.

Afterward they lay quiet, side by side, their breath slowing to normal. Eventually Khal pushed up on her elbow. When he smiled, she traced her finger over his lips. Then she reached for her robe.

He caught her around the waist. "Where are you going?"

"I . . . have, ah, Estate business."

His drowsy contentment began to fade. The histories he had read of the Twelve Estates treated love like a fine wine to savor. The idea of a Manager leaving her Akasi on their wedding night would have appalled the poets. Of course, those were all romanticized folktales, but even so, he found it hard to believe Khal's behavior was normal.

He drew her down next to him. "Surely it can't be so important that you have to go now."

At first she lay stiff in his arms. After several moments, though, she relaxed. "Perhaps not."

"Khal, what's wrong?"

It was a moment before she answered. Finally she said, "You are a wonderful lover. But . . ." She touched the gold guard on his wrist. "It is unusual for an Akasi on his wedding night to show your, ah—expertise."

Oh, Lord. She was upset because he wasn't a virgin. He shouldn't have been surprised. Even so, it threw him. "You knew I wasn't Coban."

Disappointment washed over her face. "I had hoped you would tell me that I erred. Your behavior in Dahl was said to be above reproach."

After everything else that had happened in the past few days, he didn't think he could face a rejection now. He was tempted to tell her what she wanted to hear. But to hide the truth would be a tacit agreement that he had done something wrong. He had never dated much, but the one woman who had loved him had meant a great deal to him, despite everything, and he didn't intend to diminish that by lying.

"I was a guest at Dahl," he said. "I respected the customs of my hosts. But my life was formed by a different culture. I'm not ashamed of that."

"In this culture of yours—were you—" She spoke with difficulty. "Free with yourself?"

He thought of all the times he had sat around with his friend Wayland, a grad student in computer science, the two of them grumbling about their lack of a love life. Dryly he said, "No. Not at all."

"You bring such skill to your lovemaking." A hint of mischief touched her smile. "It must be natural talent."

Or loneliness, he thought. He understood the question behind her compliment, though. "I was engaged years ago."

"Engaged?"

"It's an English word. It means spoken for. I suppose you could say betrothed, though that's more formal."

She tensed. "A woman waits for you on Earth?"

"No." Even after so long it hurt to remember. Miranda had ended the engagement months before he left for Coba. She had no interest in following him to exotic places, and he had never fit in with the influential circles she traveled. What had hurt most was knowing she believed he wasn't good enough for her crowd. He wondered what she would think when she learned that instead of her, he had married one of the most powerful women on an entire world. Let her chew on that.

Khal was watching him again. "This woman who stole your virtue—she also broke your heart."

He wished his face didn't show his emotions so clearly. "Something like that."

Gently she said, "Then let us make an agreement."

"An agreement?"

"I will try to accept your past."

"And in return?"

"You will try to accept being my Calani."

He exhaled. "I can't."

"Try, Jeremiah. I don't want you to be unhappy."

After a moment he said, "I'll see." He could never stop trying to return home. But while he was here, he could try to make the best of this. It was better than staring out the window all day without eating.

That night he slept among silk pillows in the arms of his wife—a world leader, kidnapper, and enigma.

The main common room in the Calanya was large and airy, with many arched windows that let in streaming sunlight. The furniture and floor were polished snowfir wood. The walls started as a rich gold near the bottom, blended into lighter hues higher up, and turned white at the top, with a ceiling as blue as Coba's sky, a deeper shade than on Earth.

Several men sat at a table playing Quis. Kev avoided them and led Jeremiah to an alcove. It had no benches, but the plush rug provided plenty of comfort. When Jeremiah sat among a scatter of cushions, his toes sunk in the pile.

Kev sat across from him and untied the dice pouch on his belt. "We will start with a simple round."

"All right." Jeremiah couldn't figure out Kev. The man didn't appear to enjoy his company at all, yet he had offered to introduce Jeremiah to the other Calani. Now he wanted to play Quis instead.

So play Quis, he thought. Until he understood the dynamics of the Calanya, it seemed best to follow Kev's lead.

He untied his own pouch and poured out a colorful set of balls, cubes, rods, cones, bars, polyhedrons, disks, and other shapes. The older pieces were glass or painted wood. In contrast, the Calanya dice Khal had given him were all gems or precious metals, a full set and more, including unusual shapes he had never seen Outside. He still kept the older dice, though. He had grown attached to them.

"What do we bet with?" he asked. As far as he had seen, Calani had no money.

Kev spoke coolly. "We have no need of bets. It is a device created by Outsiders to hold their attention."

A boy of about fourteen came into the alcove and dropped onto the carpet by Kev. He spoke to Jeremiah in the rich cadences of the Viasa highborn. "Why would you want to bet?"

Kev turned to him. "One should not interrupt a teaching session, Hevtar." When the boy flushed, looking for all the world like a skittish colt, Kev smiled. "Perhaps you might join us?"

Hevtar's embarrassment vanished. "I would like that."

Kev glanced at Jeremiah. "My son."

Jeremiah nodded to the boy. Hevtar resembled his father, with the same dark hair and even features, though his eyes were gray instead of black. Apparently he also shared Kev's talent for Quis. Jeremiah hadn't realized a father and son might end up in a Calanya together.

He wished he could write about the Calanya. After giving him their vow of illiteracy, the Cobans had taken all his notes and the final draft of his dissertation. When he realized they never meant to return any of it, he had gone into one of the few rages he had ever experienced in his life. To have labored for so long, with such love for his work, and then have it taken away just when he finished—it had devastated him.

Kev was watching his face. "If you object to Hevtar joining our session, he can observe."

"I don't mind at all." Jeremiah nodded to Hevtar. "Join us, please."

Hevtar took out his dice, then pushed his Calanya bands higher up on his biceps. He wore one on each arm. His were thinner than Jeremiah's, with less engraving. Kev wore both types, one like Jeremiah's on each arm and two of the simpler style. Jeremiah wanted to ask them about it, but something stopped him. Hevtar gave him an odd sense, as if he simmered with distrust.

Kev placed a ruby ball on the carpet. "Let us make a simple start." He tapped the die. "Viasa."

Hevtar set a darkwood arch beside the ball. "Dahl."

Jeremiah had never played Quis this way. "We name our pieces?"

Hevtar answered with disdain. "Of course not."

Kev glanced at his son with a hint of rebuke. To Jeremiah, he said, "In a sense you probably already have." He indicated Jeremiah's dice. "How long have you had these?"

"Some for years." He picked up a wooden rod. "Manager Dahl gave me a set when I arrived in Dahl." He touched a sapphire ring. "Some are gifts from the crew I worked on, presents to . . . congratulate me." It had been hard to deal with the admiration and joy his friends expressed for his "good fortune," when for him it was a disaster.

"They must have liked you very much," Kev said. An undertone pulled at his voice, as if he resisted believing his own words. "Tell me about your dice. Do you associate them with people, places, objects? Thoughts? Concepts?"

"In a way." Jeremiah's mind had always given color, texture, even personality traits to everything from simple mental images to abstract math concepts. With Quis, his associations became so vivid, the dice almost seemed alive.

Kev indicated the playing area. "Let yours interact with ours."

Jeremiah set a silver octagon by Kev's ruby. "Manager Dahl."

An amused voice sounded behind them. "Is this basic Quis?" A man with gray hair stepped past Jeremiah and knelt on the rug. He balanced an opal disk on Hevtar's arch so it shadowed the other dice. "Minister Karn."

A sandy-haired man a few years older than Jeremiah sat next to Hevtar. He placed a black sphere outside the opal's shadow. "Manager Varz."

Jeremiah wondered if they always barged into a game this way. Then it occurred to him that this might be what Kev had meant by introducing him to the others. With Quis.

The older man was elegantly thin, with the tall stature common among Cobans. Meeting Jeremiah's curious gaze, he said, "I am Savan." Although he too had the Viasa reserve, he gave off none of the dislike the boy Hevtar emanated.

The younger man smiled. "I am Niev." He actually looked friendly. "Welcome to Viasa, Jeremiah."

"Thanks," Jeremiah said.

"So." Savan surveyed the dice. "Shall we continue?"

Kev snorted. "Only one outcome exists." He dropped an obsidian block on the structure and it collapsed. "Varz."

It was an odd "move," but Jeremiah understood what Kev meant. Karn and Varz, the two most powerful Estates, had gone to war ten years ago. To say it had disrupted the Twelve Estates was an understatement.

Intrigued, he considered the dice. Could they tell history with the game? He set a bridge into the toppled structure so it linked the Karn and Varz cubes. Then he said, "The Karn and Varz negotiations after the war."

Savan nodded to him. Then they all resumed play. They soon stopped describing their dice, as the interactions among the pieces became more complex. Jeremiah had never played such Quis. They weren't trying to beat one another with competing structures. Instead, they all worked on the same pattern, using it to describe the war.

He already knew most of the history. However, the Viasa dice players had a different view of the war's most famous casualty, a Calani named Sevtar. Jeremiah knew Sevtar had died in the final battle, when Varz attacked Karn, but he had never realized the war *began* over Sevtar. Karn and Varz went to battle for a Calani—and both ended up losing him.

As the Quis session ended, Jeremiah sat back, enjoying a satisfaction similar to what he felt after he read a well-written history for his research.

Savan gave him a look of approval. "You learn fast."

"Thanks." Jeremiah indicated the structures sprawled across the floor. "Can you describe all history this way?"

"Not only history," Savan said. "We project futures, model political strategies, and design trends."

Jeremiah rubbed his chin. "You all seem to know everything that happens among the Twelve Estates. How? You never leave the Calanya and you receive no Outside input."

"I used to think they knew everything too," Hevtar confided, warming to Jeremiah. "But they don't, really. Even father, with three levels, can't know everything."

"Three Levels?" Jeremiah glanced at Kev. "That means how many places you've lived, doesn't it?"

"Not exactly," Kev said. "It refers to the Estates where a dice player has been in the Calanya." He touched the top band on his arm. "I did my First Level at Ahkah." His fingers brushed the second band. "Then Varz for a few years." His touch lingered on the third band, the most elaborate. "Then I came here."

Jeremiah could see the advantage of having higher Levels in a Calanya. When a dice player switched to a new Estate, he would bring knowledge with him that no one else knew except his former Calanya and Manager. It gave the new Manager political advantage over the previous. He had no doubt the price of higher Level contracts went up exponentially. The Oath also began to make sense, at least the part about no communication with Outsiders. It provided a way to secure the knowledge contained within the Calanya.

"You advise Manager Viasa, don't you?" he said.

Savan nodded. "Advise. Shape power."

"But the Oath makes you rely on second-hand knowledge gleaned from higher Levels," Jeremiah pointed out. "Doesn't that weaken your effectiveness?"

Savan shook his head. "Quite the contrary. It is our greatest strength."

"We are almost a closed system," Kev said. "The Outside touches our Quis only through Khal. Any other input—speech, reading, writing—contaminates our work. The only way to affect a Calanya is through its Manager. She must be supreme at Quis, to counter Outside players—such as other Managers—who seek to influence or infiltrate her Calanya."

New ideas were forming for Jeremiah. "Would you all play another session with me? I want to try something."

Niev grinned. "Certainly." The others nodded with approval. Apparently an urge to play Quis and learn from more senior Calani was more acceptable to them than Jeremiah staying by himself all day. He wasn't sure yet how he felt about living in an arrangement as communal as a Calanya, but so far it was tolerable. His suite allowed him a retreat when he needed privacy.

Jeremiah set a silver disk with gold spirals in the playing area. As the session evolved, he wove his concepts into his moves, at first puzzling the Calani, then intriguing them. He shaped an idea: the twelve Calanya on Coba were like secured, primary nodes in a culture-spanning network analogous to a computer net. The players Outside acted as nodes and links in an ever-evolving web shaped by the Managers and Calanya.

Everyone in the Twelve Estates played Quis, from the day they were old enough to hold the dice until age left them too frail to lift the pieces. Quis conveyed news, data, stories, gossip, trends, and more. Outsiders learned new moves and passed them along in their own game, influencing their opponents. So information spread, not through electronic, optical, or quantum machines, but in the malleable, subjective experience of Quis.

The other Calani picked up his intent with a skill far greater than anything he had known Outside. He had thought himself good at Quis, parlaying his knack for the gambling version into a notorious reputation. Now he felt like a novice. Even Hevtar surpassed his skill. Instead of playing against one another, though, they all worked together, reshaping Jeremiah's ideas, challenging his moves. So he absorbed meaning from the patterns.

He had known Calani were elite dice geniuses who gave a Manager prestige based on their reputation. However, he hadn't realized they took such an active role in shaping their culture. With her Quis, Khal input information into the Calanya: with their Quis, the Calani studied problems and designed strategies. They output their results to Khal and she analyzed their work. She then played with selected aides, who played with others, and so on, until Viasa's input into the general Outside web spread like ripples in water. The better a Manager played Quis and the stronger her Calanya, the greater her influence.

Quis was power.

Exhilaration swept over Jeremiah, the rush he always experienced with an exciting discovery. Lord, he wished he could write an article on this. He saw just how to open the paper, develop the ideas, and argue his conclusions.

Then his excitement faded. Fine. So it would make a great paper, maybe win him grants. Unless his situation changed, he would never have a chance to do anything with this new knowledge.

His concentration on the session began to slip. Savan finally paused in the process of placing a die. Hevtar yawned and several other Calani shifted position, rubbing their eyes or looking around.

"Perhaps we should take a break," Savan said.

Agreement rippled around the players. As people stretched and rubbed kinked muscles, Kev regarded Jeremiah. With difficulty, he said, "I see now why so many Managers bid for your contract."

To Jeremiah's surprise, the others made quiet sounds of agreement. Savan said, "An intriguing idea of your people, to play Quis with machines."

Jeremiah smiled at the comparison. He supposed, from the Coban view, computer webs were a poor imitation of Quis, dead rather than alive.

"I'll bet you could come up with great games on these computers of yours," Hevtar said.

Jeremiah laughed. "You can indeed." More ideas for articles came to him: a comparison of top level gamers on Earth with Quis players like Hevtar; an analysis of Quis as a means of redirecting aggression from warfare to strategy games; a study of the sensual link between Quis and Coban male-female dynamics.

It all would make a veritable gold mine of scholarship—except the same institution that so excited his interest also made it impossible for him to pursue his work.

II
An Oath Unasked

Jeremiah glanced out his bedroom window at a crisp, clear morning. Pulling on a sweater, he went into the common room. Across the way, Hevtar was coming out of his own suite, rubbing sleep from his eyes.

The boy blinked at him. "You're going again?"

"Every morning," Jeremiah said.

A group of Calani was eating breakfast at a table. Niev looked up. "I went with him yesterday," he told Hevtar. "It was terrible. Truly terrible. I thought I would die." Then he flashed Jeremiah a conspiratorial grin.

Jeremiah smiled, glad for Niev's friendly nature. In the fifteen days since he had come to Viasa, only Niev had shown any warmth. The other Calani maintained their reserve. When they played Quis, though, he became one of them. He enjoyed Calanya Quis almost as much as his research.

Hevtar held himself even more aloof than the other Calani. Jeremiah liked him, though. The youth reminded him of himself at fourteen, fascinated with his studies to the exclusion of all else. He didn't think he had ever been skittish or moody like Hevtar, though; he tended more toward what his friend Wayland described as "amiable stoicism with your head lost in the clouds." That stoicism hadn't come easy; as a child he had ached with the ridicule he endured in school because of his awkward appearance, high grades, ineptness in sports, and lack of a fighting instinct.

In contrast, Hevtar had a fresh innocence untouched by the Outside. He had spent his youth as a prodigy sheltered from the world. Then at fourteen he entered the Calanya. Jeremiah wouldn't have traded his youth for Hevtar's, though. It was true the boy had never had to deal with the spirit-crushing experience of constant derision, even physical violence from his peers. Hevtar had lived with great honor since birth. Although it might give him a happier life, it also left him less socially mature. Jeremiah doubted the high-strung, handsome genius could survive Outside, whereas Jeremiah had always known he could make it on his own.

Hevtar started to smile at him, then stopped. It wasn't the first time he had resisted an impulse to friendship. Now he turned away and joined the group at the breakfast table as if no one else were in the room.

Jeremiah stood for a moment, stung by the rebuff. Then he took hold of himself and went to the double doors of the common room. Opening the ornate portals, he found his escort at a round table Outside, playing Quis.

The captain blinked at him, then looked at the others with bewilderment. "He wants to do it again."

"Jeremiah, you should relax," another guard urged. "Have breakfast. Enjoy yourself."

With a half smile, he leaned against the doorframe and waited. Being an Akasi had its advantages. Khal gave him anything he wanted. Anything, that was, except his freedom.

"Manager Viasa says he can go when he pleases," the captain said. Her expression suggested Manager Viasa had lost a few Quis dice from her brain. She nodded to the guard who had tried to dissuade him. "You go, Aza. It makes me tired just watching him."

Aza sighed, rising to her feet. She went with Jeremiah back Inside and through a maze of halls that let them out into the parks. Then she paused, squinting as if she hoped he had changed his mind.

He grinned at her. Then he set off for his morning run.

The mountain air exhilarated him. The parks were ideal for running. They started out as well-tended gardens, then tangled into untamed forests that hid chill sapphire lakes. The ever-present wind rippled the forest in waves, ethereal in its wild beauty.

Although linguists translated the Teotecan word for these trees as *snowfir*, they hardly looked like firs to Jeremiah. At this high altitude they grew only about twenty feet tall. Their trunks consisted of slender white stalks that spiraled around each other. Clusters of white or pale green fruits bobbed around them, attached to the trunk every few inches, like snowy billiard balls but delicate and hollow. The pale green needles on the trunks could jab a person like bee stings and left punctures that took days to heal.

The path he followed wound through the edges of the forest. He had started running three years ago because his poor showing on the Dahl construction crew had embarrassed him. Overweight and out-of-shape, he had struggled through his shifts. Now he enjoyed running for its own sake. He would have liked a partner, but he had yet to convince anyone on Coba that it provided a sane form of exercise.

Had his stay in Viasa been voluntary, he would have thrived. Calanya Quis not only fascinated him as a research subject, it was fun to play. The Calani took it far beyond what he had learned Outside. Savan's game incorporated the wisdom of an expert who had spent decades mastering the dice. Niev's style reflected his good-natured outlook on life. Hevtar played with a naivete that stumbled at times and soared at others.

None of them, however, could match Kev's formidable gift. During one session the Third Level gave every detail about the failure of a beacon that warned riders in the mountains. It was powered by the Viasa-Tehnsa dam. Yet Jeremiah knew Kev and Khal had discussed it only with dice, never words. And Kev's Quis brilliance only began in his ability to process huge amounts of information. With style and flair, he manipulated abstract portrayals of the political fluxes among the Twelve Estates, molding the very flow of power on Coba, for Viasa and for Khal.

Jeremiah often found Khal in his thoughts. He had never known anyone like her. He couldn't imagine a woman of her status on Earth paying him any attention. Even if she had, he would have been too flustered to respond. Khal, however, liked his reticence. It was, after all, a Viasa trait, and expected to some extent for men throughout the Twelve Estates.

A massive wall enclosed the parks, with sculpted holes and ridges that let it act as a windbreak. As he ran along the wall, he left Aza behind. She was walking on top of it, watching him, her gun at her hip, the wind whipping her tawny hair around her shoulders. She made an impressive figure, towering and muscled, lean under her violet uniform. He wondered if Coban women had always been this big, or if they had bred for those traits over the generations.

Jeremiah grinned. *You can't solve everything with brawn,* he thought to Aza. Then he grabbed a handhold on the windbreak and started to climb.

"Hey!" Aza yelled.

Looking up, he saw her striding in his direction. As he neared the top of the wall, high above the ground, the wind picked up, ripping at his hair. Aza was running now. He smiled, wondering if she thought he would climb down the other side and vanish into the mountains. Maybe he should.

He changed his mind when he reached the top.

Even knowing the south and north sides of Viasa ended in cliffs, he wasn't prepared for the reality. The builders had cut this windbreak out of the mountain. On the other side, the cliff plunged down in a vertical wall until it vanished into clouds. Far below that, mountains carpeted with mist rolled out to the horizon. He stood braced against the wind, an intense blue sky arching around him, vibrant and dark, as if he were on the pinnacle of the world.

Aza came to a huffing stop next to him. "Are you *crazy!*" she shouted, her voice almost lost in the wind.

Jeremiah grinned.

"If anything happens to you," she puffed, "Manager Viasa will throw me into prison and melt down the key."

With a laugh, he let himself down the inner side of the wall and started back to the parks. Aza followed, grumbling. As they descended into quieter air, her mutters resolved into words. "Crazy. Runs in circles and tries to fly. What ever happened to normal Calani?"

"I never claimed I was normal," he pointed out.

She froze, then looked down, her face red. "Heh, you! Are you going to talk and get me into trouble?"

"How will you get into trouble?" He jumped down onto a lawn of tiny snowsphere clusters. "No one is here to see."

She jumped down next to him and peered through the snowfirs at the distant Estate. "So. Maybe not." Turning back, she regarded him as if he were forbidden fruit. "I have to ask you something."

"Yes?"

"It's about the Skolian Imperialate."

"I'm no expert on Skolians."

She lowered her voice. "Is it true a man commands their military?"

"Well, yes, it is."

"No! You make fun of me."

Jeremiah laughed. "It's true."

She glowered at him. "Pah."

"Where did you hear about it?"

"A whole slew of you Earth people came around here last year," she explained. "They installed the computers Manager Viasa bought from them. One of the men told me." She grinned. "Nice-looking fellow. Like you."

"I didn't know Khal bought an Allied computer system."

Aza shrugged. "They've had it a while. No one here really knows how to use it, though." She leaned closer. "So it's true? Imperator Valdoria is a *man?*"

Mischief tugged at him. "You bet. He's bigger than you, tougher than a clawcat, and meaner than a cheated dice player."

"Oh, blow."

"It's true. His title is Imperator Skolia, though. Valdoria is his family name."

Aza scowled. "Valdoria-pootoria. Put all you offworld men in a Calanya and you wouldn't cause so much trouble." She pondered the thought. "Of course, none of you can play Quis worth spit."

"Spit, pah. I could Quis you out of your home, job, and every gold thread you own."

"A fledgling Calani and already he's conceited." She put her hands on her hips. "You think I can't play Quis better than an offworlder? I can prove you're wrong."

"I'm not supposed to play Quis with you."

"So now he's a perfect Calani."

"I don't have money to bet."

"You don't need it." She gave him an appraising look, her gaze traveling up his body with obvious suggestion. "I know something I'd rather win from you anyway."

Jeremiah's smile vanished. Suggesting a man go to bed with a Quis opponent to pay off his debts amounted to calling him a prostitute. It floored him that she would imply such to the husband of an Estate Manager.

His reaction must have shown on his face. She frowned. "Don't act so traumatized. You're the one who broke your Oath. What did you expect me to think?"

"You thought wrong."

"Rumor says you weren't a husband by choice." Aza leaned against the windbreak. "You're a healthy young fellow. Who could blame a body for thinking you'd want a change from a woman seventeen years your senior?"

Jeremiah crossed his arms. The age difference made little difference to him. Khal's formidable reserve bothered him far more. Even after fifteen days he had no idea if she felt anything for him beyond physical desire.

"So paradise has problems, heh?" Aza made a sympathetic noise. "You can talk to me. I'm not just your guard, you know. I can be your friend too."

Friend? After she practically called him an adulterer?

A defensive note crept into her voice. "I know I'm not high-level like you. But I'm no airbug either. Why, I personally saved Viasa from collapse."

"From collapse?" He raised his eyebrows. "So how come I never heard about it?"

"Well," she amended. "Maybe not *full* collapse. But Viasa and Bahvla don't get along."

"You mean Bahvla Estate?"

"That's right. Manager Bahvla sent an agent here to spy on the Calanya." She looked smug. "I caught that scuttle-slug. Stomped her out. Put her in the Med House."

Dryly he said, "Remind me not to spy on the Calanya."

"How can you spy on what you are? Besides, no one hurts Calani. If I harmed one gorgeous hair on your gorgeous self, Manager Viasa would cork me in a bottle and throw it over the cliff." She grimaced. "That would be as bad as the time she sent me to help out at Tehnsa Estate."

"What's wrong with Tehnsa?"

"Everything." Aza waved her hand. "Without Viasa to help her, Manager Tehnsa would self-destruct."

He gave her a wicked look. "If Khal finds out you talked to me, she'll send you to Tehnsa."

She looked alarmed. "I'd rather fall off the cliff."

"I hope not." Jeremiah felt his legs growing cold. "Aza, I have to finish my run."

She shook her head. "Crazy offworlder."

He laughed, then took off again.

On a morning when frost traced patterns on the window, an octet of guards showed up at Jeremiah's suite. He recognized none of them. As they escorted him through unfamiliar halls, he grew uneasy. Had something happened to Khal? Last night his escort had never taken him to her suite. Although he didn't see her every night, they spent most together, and if work kept her away she sent a message.

They left him alone in an office paneled with darkwood. Armchairs stood on bronze rugs, and a desk across the room sat by a floor-to-ceiling window. Bookshelves lined the walls. A globe of Coba spun lazily on a stand, its huge polar ice caps glinting.

The door opened behind him. He turned as Khal entered the room. It was odd to see her wearing dark trousers and shirt, with her braid hanging down her back. At night, she unwound her hair and relaxed in a robe.

She closed the door and came over to him. Standing with her this way made him even more aware of her height. She also looked tired, as if she hadn't slept.

"Is something wrong?" he asked.

She wasted no time with formalities. "I realize the damage you caused my Estate resulted from ignorance. But understand me, Jeremiah—the sentence for a native Calani who committed such a crime would be prison."

He stared at her. "What are you talking about?"

"Your Oath. And Aza."

So. Someone had found out he had been talking to his guard these past few days, during his runs. "I'm sorry you're upset. But I never took the Oath of my free will. Besides, Aza and I only shared a few friendly exchanges."

Her voice turned to ice. "Friendly?"

He suddenly realized at least part of the reason for her anger. Apparently Aza wasn't the only one who had misread his desire to speak. "We only talked."

She pushed back disarrayed tendrils that had escaped her braid and curled around her face. "Is this truth?"

"Of course it is. Don't you know me well enough to see that?"

The relief that broke through her reserve and washed over her face answered him more would have any words. In a more natural voice she said, "Kev and Savan suspected the two of you were talking several days ago. But they hesitated to speak. Such an accusation is a serious matter." She shook her head. "I had good reason to trust Aza. A few years ago she uncovered a Bahvla plot to infiltrate my Calanya. Now it appears Bahvla arranged the episode so Aza could gain my trust."

He didn't want to believe Aza had used him. Although he found her abrasive, he had thought she might help him escape. And she enjoyed talking to him. Surrounded by the reserved Viasa Calani, with his even more reticent wife for company in the evening, he missed simple conversation.

Finally he said, "This Calanya Oath is loneliness."

She watched his face. "I had thought . . . you seemed happy."

"At times I am." As much as he wanted to reach for her, to tell her how much he valued their nights together, he held back, wary of her cool nature. "But the seclusion, the constraints—it will never be natural to me."

She exhaled, stirring a lock of hair that curled around her cheek. "Jeremiah, I understand. But if you can't keep the Oath, you can't live in the Calanya or play Quis with the others. You would have to stay in a solitary suite. Input of any kind alters the patterns you build. As a Calani, you are a master of the dice. Everything that affects you goes into your Quis and from there into Viasa."

He shook his head. "I just don't see how my talking to Aza could cause a problem."

"Which is why she homed in on you." Khal touched his arm. Then her reserve slid back into place and she withdrew her hand, putting the invisible wall between them that always came up, except when they made love.

"Aza would never have dared speak to a native Calani," Khal said. "She went after the one person vulnerable to her. She purposely misled you, as with her lie about our inability to use the new computers. That all went from your dice into the Calanya Quis, then into mine, and from there into the public net. Her patterns were subtle, but repetition on the Outside magnified them. It made Viasa look incompetent." She paused. "Aza also encouraged you to give her information, such as your knowledge about Skolians. She took all that to Bahvla, giving Bahvla advantage over Viasa."

He just shook his head, feeling as if he had taken a punch in the stomach.

Khal spoke in a subdued voice. "I feared you had chosen to sabotage Viasa, to strike at me."

The surprised him. "Why? It wouldn't have convinced you to let me go."

"No. But it would have given you revenge."

That she would even wonder if he might act out of malice bothered him. He lived by a simple principle: don't hurt people. It didn't work all the time, nor were his decisions always clear-cut, but he stuck to it as best he could. "I would never harm my own wife that way. Or Viasa. The people here never did anything to me. Hurting them would only make me like myself less."

Some of her tension eased. "If only all of us were as even-natured."

Bitterly he said, "Sometimes I wish I wasn't."

"Eventually you will adapt to our ways."

"How?" He heard the betraying loneliness in his voice. "How can anyone adapt to the isolation? Look at Hevtar. I'm the Calani nearest to his age, and I'm ten years older. What kind of life is that for a fourteen-year-old boy?"

Khal tensed. "Hevtar is unhappy? You have seen this?"

"Well, no." Her dismay startled him. "He seems very content." Dryly Jeremiah added, "As long as he doesn't have to see me."

Khal sighed. "Don't judge him harshly. He has loyalty to his father. He will overcome his resentment toward you."

Jeremiah couldn't imagine why Hevtar would see him as a threat to his father. No one could touch Kev at Quis, least of all him. "When I see Kev and Hevtar together, it reminds me of how much I miss my own family."

Her face took on an odd expression, as if he were forcing her to confront a decision she wanted to avoid.

"What is it?" he asked.

She pushed back her hair. Then she went to her desk and touched a panel. When a drawer slid open, she removed a silver disk. "This came in at the starport eight days ago. Dahl serves as our contact, so a robot drone delivered it there. Manager Dahl sent it to me."

His pulse leapt. Without thinking through her probable reaction, he strode to the desk and reached for the disk.

Khal drew back her arm. "Your Oath."

His need to hear the disk swept over him. Who sent it? His family? Maybe he could wrest it away from her. She had height and muscles to her advantage, but he was faster.

Slow down, he told himself. Even if he managed to take the disk, it wouldn't be long before his guards showed up and knocked him out. Then what did he have? He preferred an option that neither antagonized nor injured Khal.

"If you weren't going to play it," he said, "why show it to me?"

She hesitated. "It is difficult to know what to do."

"My hearing it won't change my Quis. My wish to go home is already in every game I play."

To his surprise, she didn't deny his words. "I know. I try to mute it, but I can only do so much. The people of the Twelve Estates know how you feel."

"Doesn't that weaken your Estate?"

"It does make Viasa look—barbaric," she admitted. She spread her hands. "We live in a modern age, with legal and social restraints on how we court our men. Even Managers must operate within certain social bounds. I knew I would receive censure for giving you no choice. And I have. I wanted you enough to go through with it despite that." Obviously self-conscious, she said, "But I've also found—well, I think many of our women would secretly like to return to the days when a warrior could carry off a husband for herself. They see me as an ancient warrior queen and you as the captured prince. That seems to have enhanced my image. People find it rather, well—mythical."

He stared at her, floored by such strange statements, especially applied to him, Jeremiah Coltman, geek of the anthropology department. Although he had lost his chubby build, he otherwise had a view of himself far different from how the Cobans saw him. Or not different, but rather, the same qualities that had made him unsuccessful with women on Earth had the opposite effect here. Unfortunately, there was such a thing as too much "success."

"Your world is a lot different than mine," he said.

"I imagine so."

"But Khal, given all that, you must see that my hearing the message won't change my Quis."

She paused. "It is hard to judge the effect before the cause."

Softly he said, "Play it."

Khal regarded him. Then she clicked the disk into a computer port on her desk.

His father's voice floated into the still air. "Hello, Jeremiah. If this finds its way to you, I want you to know we are doing everything possible to free you. Your mother and I are also working with the authorities to obtain travel clearance for Coba. We won't give up." Then his mother spoke, her voice strained. "All our thoughts are with you. Your brother and sister send their best. We love you, Jeremiah. We *will* see you again, I'm sure. Love always, Mom and Dad."

The disk hummed into silence.

His hands clenched the desk. He saw through their optimism. Visiting Coba shouldn't take that much red tape—unless the authorities feared they would cause trouble. Even if his parents did make it here, the Cobans would never let them near him. He might never see his family again.

"I am sorry," Khal said. "I shouldn't have told you."

He fought back the tears that threatened his eyes. "You would understand how they felt if you had children."

She froze. "What makes you think I have no children?"

"How could you? We've only been married a few tendays." Belatedly he realized he might have just made a terrible gaffe. She could have been married before. What if she had lost a husband? Or she might have illegitimate children. That seemed unlikely, though, given her conservative nature.

"How could you think I had no husband?" Khal asked.

"You never mentioned one."

She leaned against the desk. "Ah, no."

Jeremiah tensed. "What does that mean?"

"How could you not know?"

"Know *what?*"

"I had another Akasi. We stopped years ago."

"Stopped?" What did that mean? "Where is he?"

"In the Calanya."

"Still?"

She tilted her head. "He and I are no longer Manager and Akasi. I wouldn't be here with you otherwise. But the Oath is for life. I swore him support and protection. Our estrangement doesn't negate my responsibility."

Dryly Jeremiah said, "We call it alimony."

"He told me that he visited you on your first night here."

"*Kev?*"

"Yes." She pushed her hand through her hair. "Kev."

"He didn't say a word."

"You must have seen his Viasa armbands. They are like yours."

"I didn't understand." He did now, though. No wonder Kev wished he would fall off a cliff. And *Hevtar.* How could he have missed it? Yes, the boy had many of Kev's traits. But his resemblance to Khal was also unmistakable.

Khal spoke softly. "I regret that you had to find out in this way. I assumed you knew. You have learned so much about us that I sometimes forget you don't know our culture as well as we do ourselves."

He walked to the window and gazed out at the sky. "I need to think about all this."

"Would you prefer to return to your suite?"

Relieved, he nodded.

He spent the rest of the day in his window seat, thinking about Kev and Hevtar. He wished human relationships were as easy to understand as Quis.

Hevtar walked into the common room. "It's her!" He came to the table where Jeremiah and several other Calani were playing Quis. "I saw her windrider from my window."

"Pah." Savan looked up from his dice and glared at the boy. "Calm down. I can't concentrate."

"I *am* calm," Hevtar said.

Niev smiled at Hevtar. "Quite an occasion when Her comes to visit. Whoever Her is."

"Manager Tehnsa," Hevtar said.

Jeremiah was relieved for an excuse to leave the game. Since his talk with Khal yesterday, he hadn't felt much like playing Quis. "The infamous Manager Tehnsa? This I have to see."

"You better hurry," Hevtar said. "Her rider already landed."

It surprised Jeremiah that Hevtar didn't rebuff him. Curious about what could convince the youth to forget his resentment, he followed the boy into his suite. Hevtar took him to a window that overlooked the airfield. Gazing down and out, Jeremiah saw Khal walking across the distant tarmac with a group of people.

"Which one is Manager Tehnsa?" he asked.

"The woman with the black hair," Hevtar said.

Jeremiah studied the graceful figure. "Woman" wasn't really the right word. Manager Tehnsa couldn't be more than sixteen. A waterfall of black hair fell down her willowy back, glossy in the sunlight. "She's beautiful."

"Yes," Hevtar agreed, with great emphasis. In a shy voice, he added, "She's nice too."

Jeremiah smiled, wondering if Khal knew how her son felt about the Tehnsa Manager. It seemed an apt pairing, the son of one Manager with another Manager.

Hevtar suddenly seemed to realize who he had invited into his room. He stopped smiling. "I didn't mean to disrupt your Quis game."

"You didn't. I wanted to quit."

"Oh." The boy looked out at the airfield.

"Hevtar." Jeremiah hesitated. "I wanted to say . . ."

Hevtar looked at him. "Yes?"

"I'm sorry if I've caused you any difficulty by being here."

Hevtar shifted his feet. "It isn't really my business."

Jeremiah searched for words. How did one discuss these things? "I didn't realize before. About your parents. I hope I didn't seem insensitive."

"I just can't . . ." Hevtar glanced toward the common room. "I have a Quis session."

"Of course." Jeremiah let it go. When he was fourteen, he doubted he would have wanted to discuss such a convoluted situation either.

They started out of the suite. Just before they entered the common room, though, Hevtar paused and gave him a shy smile. "Some time, would you like to come over and listen to Niev and me practice? He plays the lyder. I sing."

"Thank you," Jeremiah said. "I'd like that."

In the common room, after Hevtar went to his Quis game, Jeremiah headed to his suite. Before he reached it, though, he ran into Kev coming out of another common room. They both stopped, awkward with their almost-collision. Jeremiah wished he could teleport somewhere. Anywhere.

After a pause, Kev said, "Do you have a moment?"

Jeremiah shifted his feet. "Sure."

So for the first time, he went to Kev's suite. It had a living room far more luxurious than anything else he had seen, even in the Calanya. The fixtures, trim, and braziers were gold. Standing lamps had silk shades with gold ribbing. The rugs, divans, windows, tables, and walls gleamed with the understated elegance of immense wealth. Apparently Khal's "alimony" came high. Jeremiah tried not to be irked, but he didn't succeed.

"Would you care for some liqueur?" Kev asked.

"Thank you, but no." He wondered why Kev asked. Out of hospitality? Or some other motive? He had no idea if Kev knew he couldn't drink Coban liqueurs, only certain wines, teas, and boiled water.

Stop it, he told himself. If he tried to analyze every word Kev spoke, he would go nuts.

The Third Level motioned him to an armchair. As Jeremiah sat down, Kev settled into a chair across the table. He spoke quietly. "Khal told me what happened."

Jeremiah shifted his weight. "I shouldn't have been so dense."

"I owe you an apology. I have been . . . less than courteous."

"It's all right." Jeremiah didn't know what else to say.

So they sat, trying not to look at each other. Then Kev went to stand at a floor-to-ceiling window that overlooked the airfield. "They're moving Manager Tehnsa's rider to a hangar. She must be staying for a visit."

Relieved to change the subject, Jeremiah joined him. A crew was wheeling the rider across the blacktop. The craft looked like a giant bird with a bright red head, green plumage edged in black, talons black as lava, and gold eyes. "It's hard to believe Manager Tehnsa is as inept at Managing as everyone says."

"She isn't." Kev continued to watch the crew. "Caryi had an entire Estate rolled into her lap when she was only thirteen, after her predecessor died in a rock fall. Since then she has been trying to cope. Khal helps. Tehnsa is also hampered because its Calanya is small, only six Firsts and no higher Levels."

Jeremiah glanced at Kev's three arm bands, wondering if he had ever considered leaving Viasa. It would solve the problem of having to see his ex-wife and her new husband every day. "How would she go about getting a higher Level?"

Kev looked at him. "The Estate that wants him makes an offer. If he is interested, the Managers negotiate. Counter-offers are made. Other Estates may enter the bidding. The higher the Level, the steeper the price of his contract. The practical limit for most Estates is Third Level."

So. Maybe no one could afford Kev's contract. "Why trade at all?" He thought of Aza. "If one of us went to Bahvla, wouldn't that give Bahvla power over Viasa?"

Kev snorted. "Khal would never trade with Bahvla."

"But she does with other Estates."

"Not often. High-Level trades are rare." Kev brushed his Viasa band in a gesture he often used, yet didn't seem to notice on a conscious level. "Savan came here from Tehnsa two years ago. When he left Tehnsa, Caryi lost her best Quis player. But the settlement that Viasa paid for his contract allowed Caryi to clear many of her Estate's debts."

Jeremiah could see why a player with Savan's talent would want a position at a more powerful Estate. But going from Tehnsa to Viasa was like switching from a small to a large room in the same house. Kev had come from Varz, a powerhouse Estate having only a tenuous alliance with Viasa.

Another thought came to him. "You must have been at Varz during the war."

Kev nodded. "I knew the Calani Sevtar for a short time."

"It's hard to imagine a war fought over one man."

Kev smiled slightly. "Not if you knew Sevtar. He was bigger than life, Jeremiah, huge, powerful, strong, wild, gentle when he wanted to be, affectionate. He looked like a god and he played Quis better than anyone alive. In many ways, he was the antithesis of the Coban male, yet in others he offered everything a woman could want. It all added to his mystique."

"It certainly seems to have affected Karn and Varz." Jeremiah paused. "I don't really understand Coban women."

Kev gave a dry laugh. "I quit trying long ago."

Jeremiah smiled. Then he spoke with care. "Negotiations for your trade with Viasa must have be going on then."

Kev looked out the window. The airfield was clear now. "Fourteen years ago, Manager Varz wanted to enlist Viasa as an ally. So she honored Viasa with Quis. She chose me to play dice with Khal." It was a moment before he continued. "Khal and I discovered we suited. She negotiated with Manager Varz. The settlement put Viasa into debt for years."

Jeremiah didn't want to know this, that Khal had indebted her entire Estate for another man. "Doesn't it bother you that they buy us that way?"

"No."

"Never?"

"The Calanya is the only life I have ever wanted."

"Don't you want to go Outside? Climb a mountain? See the world?"

Kev turned to him. "No."

"Oh." Jeremiah didn't know what to say to that.

"You would have liked Sevtar." Kev smiled. "He also had this habit, running circles in the Calanya parks. He was an offworlder, too. A Skolian."

Jeremiah stared at him. "You're joking."

"Not at all. His ship crashed here almost thirty years ago. Now the Managers are afraid."

"Afraid? Why?"

"He came from a powerful Skolian family." Kev regarded him. "One that could cause Coba great harm if they knew what happened here. The Managers changed his name and identity. The name Sevtar is Coban, our god of the dawn. None of us knew Sevtar's real name. We don't make his story a secret, because its discovery would draw even more attention. However, we say very little about him to offworlders."

Jeremiah just looked at him, his unspoken words hanging between them like an intruder: *You told me*. The Viasa Calani had already accepted what Jeremiah continued to deny, that he would never leave Coba.

III
Mountain Passage

The year on Coba lasted a few months longer than on Earth. It eased from winter into spring, warmed into summer, and frosted into autumn. Viasa sat so high in the mountains that when winter returned, its storms often massed below the Estate, leaving Viasa in sunshine, subzero temperatures, and ice.

Today light poured through the windows of the morning room in Khal's suite. She sat across the breakfast table from Jeremiah, lost in silence while they ate. The blue silk of her robe glowed against her golden skin, and her hair fell over her body in red-gold waves. It wasn't only her striking appearance that attracted him now, but also qualities that made her unique: the slight curve of her lips that hinted at her hidden streak of mischief, the way she looked up from her work in welcome when his escort brought him to play Quis during the day, the sultry invitation in her gaze at night. He knew he had fallen in love with her. But she remained a cipher. She never spoke of her feelings, and her face rarely revealed her moods.

"You're quiet today," he said.

She looked up, focusing on him. "My apologies. I must make poor company this morning."

"Is something wrong?"

She sighed. "One might say so." After considering him, she touched an audiocom set into the table.

The voice of her aide floated into the air. "Seva here."

"This is Manager Viasa. Please have the Allied files in my office sent up here."

"Right away, ma'am."

Allied files? Jeremiah gave her a questioning look, but she said nothing. From past experience, he knew that trying to draw her out would do no good. So they continued to eat.

After a while a girl tapped at the open door arch. "An aide is here to see you, Manager Viasa."

"Show her in," Khal said.

A woman with yellow hair entered, carrying a box about six inches on a side. When Jeremiah saw the comp disks in it, his pulse jumped. He would recognize those anywhere. They held all his notes from his years of fieldwork in Dahl.

Khal waited until the aide left. Then she regarded Jeremiah. "Yes. They are yours."

"What about my dissertation?" He didn't see the labels for those disks. "Was it destroyed?"

"Winds, no," Khal said. "We would never do such a thing. We know the dedication you put into your work."

"Where is it?" He knew he shouldn't let it wrench him this way. It didn't look as if he would be going home any time soon. He had found no way to escape Viasa or convince Khal to let him go. If the Allied authorities had made progress in negotiating his release, he knew nothing of it. He had begun to wonder if they had given up. With Coba under Skolian protection, Earth preferred to avoid any fuss that might attract military attention from the bellicose Skolians. Yet no matter how he ended up, he cared what had happened to his work.

"When the Council of Managers agreed to let you live in Dahl," Khal said, "we all understood why. Minister Karn knew you intended to write about us."

Anger edged his voice. "Maybe it didn't matter because she never intended to let me leave."

"We are not so devious, Jeremiah. Minister Karn would not lie to you." Khal touched the box. "Because of this, we owed you a debt. I paid it as best I knew how. I sent your study to your mentor on Earth."

Jeremiah stared at her. "You mean Professor Brenn? You sent him my thesis?"

Khal took a disk out of the box. A holo of the Harvard seal gleamed on its shimmering surface. "A windrider delivered this while you were still asleep."

He swallowed. "Khal, play it."

"Are you sure? It won't change anything."

"Yes." His pulse raced. *What had Brenn thought?* "I'm sure."

As she clicked the disk into a slot on the table, Jeremiah tensed. What if Brenn didn't like the work? What if he thought it incomplete or of poor quality? Even if Jeremiah could have presented his thesis to his doctoral committee, they might have found it wanting. Maybe Khal was right. Brenn's response might only dishearten him.

But he had to know.

Brenn's voice rose into the air. "Jeremiah, hello. If you are listening to this, you probably know the Cobans sent me your work." He paused. "To say their action surprised us would be an understatement. In any case, I submitted it to your examination committee."

Jeremiah blinked. Why bother giving it to the examiners when he wasn't there for them to examine him?

Brenn spoke as if anticipating his reaction. "A thesis without an author to defend it is unusual. However, after reading your work and considering your circumstances, the committee decided to accept the dissertation without your oral exam. In cases such as yours, the oral is only a formality anyway." He paused. "Your committee, the department, and the Graduate School of Arts and Sciences concurred. You were granted your doctorate during the last graduation."

They gave him a Ph.D. *without* his final defense? How? He certainly hadn't considered the oral a formality. He had feared he wouldn't pass.

Brenn continued. "Your work has provoked more talk around here than I've seen in years." He cleared his throat. "You raised quite a stir with the section on the evolution of the Calanya from a harem of the Managers' husbands into a group of elite dice players who aren't married to the Manager. Your arguments that polygamy for either sex destabilizes a society has debates going. Dean Baker claims it's hooey, Melissa Alli thinks you're brilliant, and Wayland is somehow running computer simulations on it, lord only knows how." Awkwardly he added, "But perhaps you have had more chance to test your hypotheses about the Calanya than you would have preferred."

No kidding, Jeremiah thought.

"You might like to know," Brenn continued. "You were awarded the Feldman Fellowship in Anthropology. I also submitted your dissertation to the Academy of Planetary Studies." He paused. "Jeremiah, you won the Goldstone Prize."

"*What?*" Jeremiah's hand tightened on the stem of the crystal goblet that held his water.

"I think this was the first time a Goldstone winner couldn't attend the ceremony," Brenn said. "Your award monies will be held for you until—well, until you can claim them."

After a pause, Brenn said, "Your family sends their love. We are all proud of you."

Then the disk went silent.

The stem of Jeremiah's goblet suddenly snapped. He stared at the line of red that welled from the cut on his hand. Then he dropped the glass, and it shattered across the mosaic tiles on the floor.

"Jeremiah?" Khal started to reach toward him.

"No!" He pushed back his chair with a jerk, then rose to his feet and strode away from the table. Beyond the horseshoe arch, he entered a lofty corridor. Darkwood paneled one wall but the other was glassplex. It looked out into pure sky.

Far below, the Teotec Mountains rolled away, wreathed in the mists and carpeted by richly growing snowfirs, the Forest of the Clouds. Lake-of-Shadows made a dark blue glimmer in the north and Lake-of-Tears glinted silver-blue in the south. Far to the east, the snow-covered tip of Mount Shadows Peak lifted into the sky. The panoramic view mocked him, a reminder that he lived in a gilded prison, forbidden the freedom promised by that spectacular landscape.

The hall ended in a round chamber with its back wall and floor carved from the cliff itself. The other walls were glassplex that polarized to mute the

Sun's glare. The chamber wedged into the cliff like a bubble on that great, sheer expanse of rock.

A bench jutted out from the back wall. Jeremiah dropped onto it, rested his elbows on his knees, and put his head in his hands.

Boots sounded in the entrance. He looked up to see the captain of his Calanya escort. Then Khal appeared behind her.

"You may wait in the morning room," she told the guard.

After the captain left, Khal sat on the bench near Jeremiah. She spoke with care. "These honors you received—they mean much, yes?"

"What does it matter?" He stared into the sky that arched around the chamber. "I'll never be able to accept them."

"It might help to talk."

That was a switch. Usually he was the one who wanted her to open up. Now she sat quietly, neither pushing nor withdrawing into her reserve.

After a while, he spoke. "The doctorate is what I was working on all those years in Dahl. They don't normally grant it without final processes I couldn't do here. But they gave it to me anyway." He swallowed. "The fellowship is a research grant awarded each year for work that led to a doctorate in anthropology."

"Given to only one person? Out of everyone?"

"Yes. But it's no big deal."

"No?" She regarded him. "I think this doctorate of yours and this prestigious Feldman Fellowship are far greater honors than you admit."

It had never occurred to Jeremiah that he would win the Feldman. Although he did well in research, the fellowship usually went to someone who also had a top record in academic courses. His grades were nothing to boast about. Research was what he loved, usually to the detriment of his classes.

What dazed him, though, was the Goldstone. He had no idea what possessed the Academy to give it to him. It always went to a seasoned faculty member in a major academic department. For a graduate student to win for a doctoral dissertation was unheard of. It assured him of a good shot at any academic job he wanted. He stood on the verge of realizing his dreams—and Coba had stolen them.

Khal was watching him. "This Goldstone, what does it mean?"

Jeremiah swallowed. "It means that people I don't deserve to call my colleagues think my work is the best done in our field this last year." He turned to her. "Don't you see? This is all I've ever wanted. You've taken my dreams."

Quietly she said, "It was a mistake to play the disk."

"Let me go, Khal. Let me go home."

"Even if I could take away the Calanya Oath, which I can't, we could never let you leave now. You know too much."

"You don't want me to write about the Inside."

"In part. It is private to us." She paused. "But your knowledge of Sevtar is more serious. His family wields immense power among the Skolians. If they ever learned what happened to him here, they would seek vengeance."

He shook his head. "I'll never mention him."

"I have no right to risk the safety of my people."

Jeremiah rose to his feet and crossed to the curving wall. A misty cloud drifted by below the chamber. "I don't deserve the Goldstone anyway. My work was incomplete."

Khal came to stand behind him, sliding her arms around his waist. He saw her reflected in the glass, looking out over his head at the breathtaking view.

She spoke quietly. "I know you, Jeremiah. You would never rest until you created perfection. Even then you would be dissatisfied. I read this work of yours before I sent it to Earth. You deserve every honor they gave you."

He blinked. "You read my thesis?"

"Yes. It took some time. My English is

terrible." She tilted her head. "It is strange to see the Twelve Estates through the eyes of an offworlder. But your love of Coba came through in all you wrote."

It meant a great deal to him to know she had liked his work. Even so, he couldn't tell her what she wanted to hear, that his love of her world would make up for the loss of his own. So they stood in silence, watching the sky.

After a while she said, "I attend the Council of Managers at Karn Estate soon. I have been thinking that, if you like, I will bring you with me."

He knew she never traveled with Calani. This was her way of trying to ease his unhappiness. "Yes. I would like that."

Some of the tension in her embrace eased. She drew him around so they faced each other, her arms still around his waist. "Before we leave for Council, Manager Tehnsa is coming here to visit. I would like you to play Quis with her."

That surprised him. Although Khal often had her Calani sit at Quis with Caryi, she usually chose experienced players. "Are you sure you want me to do it? Not Kev or Savan?"

Khal nodded. "I hope an infusion of new ideas will strengthen her game. You see things in a different way."

"How about Hevtar?"

"Hevtar?" She gave him a puzzled smile. "He's a child."

"Not really." Jeremiah thought back to their sessions. "He has a fresh outlook and he understands Tehnsa."

"He does have a remarkable style, doesn't he?" A mother's pride warmed her voice.

"He does. And something else, Khal."

"Yes?"

"Caryi needs a higher Level Calani. And an Akasi. Hevtar might consider it." Given what Jeremiah had seen, Hevtar would consider it paradise.

Khal dropped her arms. "Hevtar go to another Estate? As Akasi? Of course not. He is far too young."

"Aren't most highborn boys here betrothed by fifteen?"

"Well, yes," she admitted. "In more conservative Estates."

Dryly he said, "Viasa is hardly a hotbed of radicalism."

She smiled slightly. "No, I suppose not."

"You have to let him grow up."

She considered him, then walked over to gaze out at the sky. "I would miss him. So would his father."

Jeremiah understood. The deep, abiding love Kev and Khal felt for their son showed in their every word and action toward him. For all that Khal resisted the idea of a betrothal, though, he suspected she realized the match made good sense. Caryi and Hevtar were young by most standards, but the conservative upper echelons of Coban society encouraged early marriages among the highborn, to produce heirs. Tehnsa needed a Second Level, one with a fresh outlook, and Hevtar needed someone like Caryi who understood his moody, stratospheric intellect. The pairing would let him stay near Viasa, yet at the same time give him independence. He and Caryi would also have Viasa to guide them in governing Tehnsa.

Jeremiah paused. "Khal—?"

She turned to face him. "Yes?"

"What happened? With Kev and you?"

"We . . . had a disagreement."

He waited. "Yes?"

It was several moments before she spoke. But this time she did answer. "He wanted more children. I didn't."

"Hevtar is a wonderful young man."

"Yes. He is." With difficulty she said, "I have always thought it important that I give my child my best personal attention. But I am also a Manager. I didn't feel I could do both with more than one child." She paused. "My refusal caused rancor. Kev stopped caring for . . . for Viasa."

No, Jeremiah thought. *He didn't stop caring for you.* "He never left Viasa."

"I offered. Other Estates expressed interest, despite the immense cost of his contract. He didn't want to go. Why should he? Viasa is a good Estate."

Jeremiah shook his head. "The Calanya trade—that's the only equivalent of divorce that exists for an Akasi."

"I don't understand this word 'divorce.'"

"I know. That's the problem."

A long standing heartache showed behind her reserve. "I would never have brought you here if Kev and I still lived as Akasi and Manager."

"He's still your husband."

"You know my people no longer practice polygamy. You wrote this yourself in your study of us."

"But for Managers it's still legal. No matter how you evade the description, you have both Kev and me." He made himself say the truth he had avoided. "Kev will always come first for you."

"Jeremiah, no." She started toward him, but stopped when he put up his hands as if to hold her off. "Surely you know what you mean to me."

"How can I know? You never say." Pain edged his voice. "Oh, I know, you're proud of your young trophy husband. But I'm not a *prize.* What happens when you tire of your 'exotic prince'? When the novelty wears off and you want a man who understands and values your way of life?"

"You're wrong if you think you mean only that to—to Viasa."

He gave a laugh with more pain than humor in it. "You can't even say 'to *me.*'"

She spread her hands, her body silhouetted against the sky. "Perhaps you want more from me than I know how to give."

Softly he said, "That works both ways, Khal."

A loud buzzing jarred Jeremiah awake. He opened his eyes into the darkness of his suite. Fumbling on the nightstand by the bed, he switched on the audiocom.

"What?" he mumbled.

"Jeremiah?" Khal's tense voice came out of the audiocom.

Her urgency pulled him awake. "What's wrong?"

"Can you read starship trajectory scans?"

Puzzled, he said, "I took some astronomy in college. We covered the basics. But that was years ago."

"That's more than any of us have." She took a breath. "We need you in the observatory tower. Hurry. Please."

He sat up, reaching for his robe. "What happened?"

"A starship." Strain crackled in her voice. "It's out of control and headed for Viasa."

Jeremiah ran through the Estate, surrounded by his escort. When they reached the observatory tower, he raced up the spiral stairs two at a time. They strode into the observatory, a domed room with a telescope run by antique gears. In sharp contrast, the gleaming consoles in the center of the room belonged to the modern computer network Viasa had been incorporating over the past year.

Khal stood at the central console, still in her day clothes, with a cluster of aides. They looked as if they had worked straight through the night. Kev was leaning over the console, studying its screens, his hair and clothes tousled as if he too had just run here from the Calanya. It didn't surprise Jeremiah to see him; Kev's mathematical gifts went hand in hand with his Quis expertise. Holographic icons glowed above one screen and data spilled across another. A third projected a holographic trajectory map for a ship already within Coba's atmosphere.

As Jeremiah came up to them, Khal indicated the trajectory holo. "Can you interpret the map? We've never had reason to work with this aspect of the system."

Jeremiah hesitated, aware of the Outsiders present.

Khal spoke quietly. "Break the Oath. Lives depend on what you know."

He nodded, then concentrated on the map. Kev moved aside, giving him a better view.

"You're right," Jeremiah said. "The ship is headed for Viasa. I don't think it is out of control, though." He looked over the console. "Will this respond to my voice?"

"Tell it your name." Khal spoke into a comm on the console. "Saje, give access to the next voice identifier." Then she nodded to Jeremiah.

He spoke in the comm. "Jeremiah Coltman."

Saje, the computer, answered. "Access granted."

"Give me what you have on the incoming ship," Jeremiah said. "Use graphics as much as you can." He had always been better at interpreting images than numerical data.

Holos of graphs and blurred space vessels appeared above several screens. Statistics flowed across others. The longer he studied the jumble of data, the more it baffled him. It was like poorly translated text, but in images instead of words. Saje couldn't even ID the type of craft coming in, let alone give details. It could be anything from a windrider to a military dreadnought.

Suddenly it hit him. "Saje, you use Allied standards, don't you?"

"That is correct," Saje said.

"Can you give me the analysis using Skolian protocols?"

"Working." The holos reformed—and this time they made sense.

"It's a Skolian ship," Jeremiah said. "Civilian, I think." He glanced at Khal. "It looks like a scout."

Relief washed across her face. She must have feared the same thing he hoped for, that the ship had come for him. If it were Skolian, though, that wouldn't be the case. More likely it was off-course for the starport.

"Will it miss Viasa?" she asked.

"I'm not sure." He studied the displays. The data was scrolling in Skolian glyphs now, which he couldn't read, but he understood the holos. Sweat beaded on his temples despite the cool air. "If it doesn't alter course, it will hit the city."

Khal exhaled. "Can we contact it?"

"I think so." He looked around. "Is your audiocom hooked into the computer's long-range signaler?"

"I don't know. What does that mean?"

"The signaler can contact the ship," he said. "When the techs set up your system, they should have linked your audiocom into the signaler or else installed a long range comm. Did they discuss it with you?"

"Not really. We had no need for it. This computer system does Estate management, not starship landing." She regarded him. "Can you set it up?"

"I don't know how. But the computer might." He leaned over the console. "Saje, can you talk to the incoming ship?"

"At the moment, no," it answered. "However, you are right that I may be able to link the audiocom into my signaler. I need details on the audiocom technology."

Khal spoke. "Look in the files on the Estate electrical systems under 'intranet connections.'"

"Working," Saje said.

Jeremiah studied the holos rotating above the console. "The ship has slowed some, but it's still coming in too fast. If it hits Viasa, it could cause a lot of damage."

"We're already evacuating, into the east canyon." Khal turned to Kev. "You better go too. My aides can take you."

He shook his head. "I'm staying."

She stiffened, her dismay at hearing his voice obvious. "You must go with them, Kev. You might be hurt if you stay."

"I'm not going to leave you," he told her.

"You mustn't endanger yourself." She lifted her arm and he started to move, as if to take her hand. Then they stopped, obviously aware of the people watching them. Khal lowered her arm and Kev took a breath.

Jeremiah stood at the console, awkward and self-conscious. He felt like an interloper. Seeing Khal and Kev together, so alike in background, outlook, and power within their separate spheres of accomplishment, he knew they were the two halves of Viasa. They shared a closeness he would never have with Khal, not if he spent his entire life here and Kev left tomorrow.

Static suddenly erupted from the comm, accompanied by a man speaking Skolian Flag. "—read me? I repeat, I'm receiving your signal. Please respond."

For an instant Jeremiah's mind blanked. Although he understood some Skolian Flag, he spoke almost none, and for the past four years he had heard only Teotecan.

Then bits of his meager Skolian vocabulary came back. He leaned over the comm. "Know English you? Spanish? French?"

The pilot switched into heavily accented Spanish. "This is Dalstern GH3, scout class II. Viasa, I need holomaps. These mountains are much trouble. The wind make problem also."

"Can you link your computers to our system here?" Jeremiah asked in Spanish. "We will help guide you down."

"I try." He paused. "Do you receive?"

Saje spoke in Teotecan. "His system uses ISC standard ninety-two. I can only process some of its input."

Khal looked at Jeremiah. "What does that mean?"

He raked his hand through his curls. "Your system was never set up for this. It does have a lot of what we need, but most of it uses Allied standards. Saje is having trouble with the form of the incoming data."

"Can you tell it the right form?" she asked.

He spread his hands. "It's like trying to translate one language to another, on the spur of the moment, when I don't speak one that well and can't say anything in the other."

"What about the pilot's computers?"

Jeremiah spoke into comm. "Dalstern, can you send your data in an Allied protocol?"

"Which one?" the pilot asked.

"Saje, help him figure it out."

"Working," Saje said.

The pilot paused. "Viasa, your data is incomplete."

"What's missing?" Jeremiah asked.

The pilot listed acronyms, none of which Jeremiah knew. When he paused, Jeremiah said, "Saje, do you understand that?"

"Enough to know I'm missing some important files."

"Viasa," the pilot said, "we are maybe close to what we need. Can you send the equations that transform the coordinate system in your primary nav module to the system we use?"

Jeremiah hesitated. "Can you do that, Saje?"

"It requires software I don't have."

"It can't be that hard to figure out.

"Whether it is hard or easy is irrelevant," Saje said. "I don't know what transform to apply. If I use the wrong one, it could do more harm than good."

"Can't you run comparisons with the Dalstern?"

"We are trying. But we have incompatibilities. It hampers the procedure."

Khal regarded Jeremiah, her face pale. "Can you tell it the right transform?"

He shook his head. "I'm no astronavigator."

"You said you studied it in school."

"I hardly even remember the Allied protocols, let alone Skolian. And I've never been that great at math."

Kev spoke. "Use Quis."

Jeremiah jerked, as startled as everyone else. It was one thing for an offworld First Level to break his Oath; another to hear one of the leading Calani among the Twelve Estates do it, not once, but several times.

"You know more than you think," Kev told him. "You wouldn't do so well at Quis otherwise. Use the dice. Use the patterns in your mind."

Jeremiah had no idea if it would work, but he had nothing better to offer. Taking a breath, he tried to calm his mind into the meditative state that often came when he played Quis. He let the few formulas he remembered rise in his mind.

Make them dice, he thought.

He sat at the console and rolled out his dice on a flat screen. In the Calanya, they used Quis to study political, cultural, historical, and social relationships; now he used it to do mathematics. He chose different pieces for different symbols, then "wrote" equations by making Quis structures.

The comm crackled with the pilot's voice. "Viasa, where is beacon to guide aircraft in these mountains?"

Jerked out of his concentration, Jeremiah knocked over a structure. Dice flew across the console.

"Ah, no." Trying to relax, he gathered up the pieces and started again.

Khal spoke to the pilot in broken Spanish. "Say again?"

"The warning beacon," he said. "Where is it?"

"Broken," Khal told him. She glanced at Jeremiah, her question obvious: *How does he know we have a beacon?*

"It's probably in a Skolian file on Coba," Jeremiah said. "Or his scanners might have found something." When she indicated the comm, he spoke into it. "Dalstern, we have holomaps for you, but we have a mismatch in protocols. We are working on it. Please stand by."

"Understood," the pilot sad.

Concentrating on his dice, Jeremiah incorporated the rules of mathematics into the rules of Quis. He was trying to derive equations with Quis. He discovered the math was easier when he thought in terms of dice structures.

Suddenly a concept snapped into place. Yes! He saw how the Skolian and Allied methods for describing spatial and temporal behavior related.

As Jeremiah gave his results to Saje, he glanced at the evolving holomap that showed the ship's progress. He could only imagine what it must be like to hurtle through the jagged Teotecs with neither maps nor a beacon. The ship obviously had sensing equipment or it wouldn't have made it this far. But it was designed for space rather than planetary maneuvers, and the savage winds in the upper Teotecs would tear a less sturdy craft apart. The ship had slowed more, but it was still coming in too fast.

"Viasa, I need maps," the pilot said.

"I'm sending what I have." Jeremiah prayed he had derived the right transform; otherwise, he could be sending the pilot to his death.

"Received," the pilot said.

Khal spoke. "Jeremiah, what can we do to help?"

"Guidance." He studied the holomap. "He's about one span north and two spans above Grayrock Falls. What's the clearest passage through there?"

"He must avoid the Heska Cliffs," Khal said. "He should go higher, one span, and to the east one third."

Jeremiah told Saje. Then he asked, "Dalstern, did that come through?"

"Part of it," the pilot answered. "I pull up."

Watching the holomap, Jeremiah spoke to Khal. "He's up about half a span. Will he make it over the cliffs?"

"He must go higher," she said. "If he can't, he should go east two spans. A small pass is there."

Jeremiah input the data and watched the holomap change. "That looks good—ah, *no!*"

The map fragmented. In that same instant, the pilot said, "Viasa, we have problem."

"We too," Jeremiah said. "Saje, what happened?"

"You only gave me a partial transform," Saje said.

Jeremiah swore under his breath. What had he missed? Struggling to focus his mind, he turned back to his dice. But his mind kept coming up with images of the ship hurtling toward them, breaking his concentration.

"Viasa, I need set-down coordinates," the pilot said.

"We're working on it." Jeremiah glanced at Khal. "Where should he land?"

"West of Viasa. Away from the evacuation."

Jeremiah stared at her. "The west is sheer cliff face." He was painfully aware of time passing. If he couldn't solve the transform problem, the pilot would have little control over where he landed—or crashed.

Kev spoke. "The Calanya parks. That will take him away from the city without sending him over the cliffs."

As soon as he saw Khal's dismay, he understood: to let a ship destroy the Calanya would violate her sense of decency at a level so basic it was part of her. He could almost feel her weighing the pilot's death against that destruction.

Then she blew out a gust of air. To an aide, she said, "Double-check that the Calanya has been evacuated." As the aide took off, Khal turned to Jeremiah. "Send him to the parks."

"It's a small area for a ship without a map," Jeremiah warned. "If he misses, he could hit the Estate."

"We must protect the evacuees," Khal said. "The Estate can be rebuilt. People cannot."

Khal's aide came striding back to them. "The Calanya is empty. The only person still there is a guard captain."

"Good." Khal motioned to her aides. "All of you, go with the evacuation. Let them know the situation and make sure they take cover in the lower end of the canyon. Even if the ship hits on that side of Viasa, it probably can't penetrate so narrow an area."

Intent on his dice, Jeremiah barely heard the aides leave. As he lifted a platinum cube, Kev said, "Wait." He reached forward and moved several pieces. "Try this instead."

Jeremiah nodded, a new pattern evolving in his mind based on Kev's moves. He continued to play. Every second that passed felt like the warning tick on an antique clock. The Observatory stood in the path of the incoming ship. If the vessel hit it, the impact could sheer off the dome and destroy everything within—including them.

He tried to think faster, but it only made his Quis frantic. Kev made another move, then changed his mind and tried a different one. Jeremiah picked up his intent and rearranged several structures. He still couldn't find the missing part—couldn't make it—

"Viasa, I have no more time," the pilot said. "I guess coordinates."

Suddenly Jeremiah saw the pattern, beautiful and elegant. "Dalstern, I have it!" He gave Saje the new equations as fast as he could trace a light stylus across the screen.

"Received." Relief washed the pilot's voice. "Suggest you get out of there. Over and out."

"Over and out," Jeremiah said, jumping to his feet.

With Khal and Kev, he raced across the observatory. They sped down the stairs and out into emptied halls. Then they ran out into the starlit Calanya parks. Wind pummeled them with fists of air, and thunder roared above the keening wind.

No, not thunder. A starship engine.

Jeremiah picked up his pace, then realized he had left Khal and Kev behind. As he whirled around, Khal stopped, staring at the sky. "*No!*" she shouted.

The ship hurtled out between two peaks high above Viasa, making a giant shadow in the sky. It wasn't big for a starship, but compared to the Estate it loomed huge. Its engines roared in the wind.

Khal took off with Kev at her side, her hand reaching out to Jeremiah as if she sought to protect both him and Kev against these forces so far beyond her control. As they raced for the Estate, the ship skimmed over the city, dropping at an alarming rate. It snapped the spire off a tower.

They slowed then, knowing they had no chance of making it to the canyon in time. Either the ship would miss them or it wouldn't. As they stared upward, they backed toward the Estate, more by instinct than because it would do any good.

The ship grazed a roof, smashing its crenellations. Then it cleared the Estate, dropping fast. It rammed down into the Calanya parks, still skimming forward. In a scream of high-pressure composite on bedrock, it tore up ground cover and blasted trees as it shot across the parks.

With an explosive crash, the ship slammed into the windbreak—and the gigantic wall shattered like glass. Crumpled but intact, the craft came to a shuddering stop, jutting over the cliff. In a nightmare of slow motion, it began to tip over the edge.

Without pausing to think, Jeremiah ran for the ship, pushed from behind by the wind as he dodged scorched areas of the parks. By the time he reached the craft, he had far outdistanced Khal and Kev. He pounded his fists against the unyielding hull. "You have to get out!" he shouted.

A hand closed around his arm and someone swung him around. Even before he looked up—and up—he knew it couldn't be Khal or Kev. Neither had such towering height. In the starlight, he couldn't see much more of the man than his massive size.

The Skolian released his arm and spoke in Spanish. "I've come for a man called Jeremiah Coltman."

Jeremiah took a breath. "I'm Coltman."

The Skolian took his chin and turned his face into the starlight, one way, then the other. Then he let go and pulled up Jeremiah's arm to look at his armbands. "So. You are. We must hurry." Before Jeremiah could respond, the man grasped his arm and took off, pulling Jeremiah with him.

As they reached the airlock, Jeremiah balked. What did the Skolians want with him? If he went with this pilot, he could find himself in a worse situation than if he stayed here.

A voice came through the wind. "Jeremiah," Khal called. "Wait!"

The Skolian spun around, his hand falling to his hip. With a lurch of dismay, Jeremiah saw that the man wore a Jumbler, a military sidearm that could destroy Khal as fast as antimatter annihilated matter. Khal and Kev stood a short distance away, Kev staring as if he were seeing a supernatural being.

As the Skolian drew his weapon, Jeremiah caught his arm, praying he didn't activate automatic reflexes that made the man shoot him instead. "Please. Don't hurt them."

Khal came closer. "Don't go, Jeremiah."

He swallowed, suddenly knowing he was going to trust this stranger. It might be his only chance to return home.

His voice caught. "I have to." After seeing Khal and Kev together tonight, he could no longer deny what he had always known at a subconscious level. They completed each other. When Hevtar left home to wed Caryi, they would probably turn to each other to fill the void. Jeremiah couldn't bear to live with Khal knowing another man would always claim her heart.

She came to him. "Don't go. Viasa has come to care—" She took a breath. "*I* have come to care. For you."

Her look was achingly familiar, the one that caressed him after they made love, that held promises of affection she never spoke aloud, always leaving him in doubt. Now she added the words he had needed to hear, and even on the brink of escape he wanted to take her into his arms and promise he would stay.

He struggled with his words, aware of

the Skolian stranger listening to them. "I'm sorry. I'm truly sorry. But I can't be what I'm not. And I could never share you. It would kill me." He swallowed. "Oh God, Khal, don't let pride keep you apart from the man you really love. Whatever you and Kev said to each other all those years ago . . . let it mend."

"Jeremiah," she murmured. The silver track of a tear slid down her face, catching starlight.

The pilot spoke with unexpected gentleness. "We must go."

Softly Khal said, "Good-bye, beautiful scholar."

Jeremiah wiped a tear off his face. "Good-bye, Khal."

The Skolian was already opening the airlock. As he paused to let Jeremiah enter, he looked back at Kev. "Don't tell anyone," he said in Teotecan. "You know why."

Then he closed the hatch, cutting them off from Viasa.

Jeremiah sat in the co-pilot's seat while the Skolian took them away from Coba. On the holoscreen, he watched Coba recede until she became a jeweled orb, a beautiful Quis die among stars and stardust. Another tear rolled down his cheek. He wiped it away, not wanting the stranger to see.

The pilot remained intent on his controls, more so than the ship probably required. His concentration gave Jeremiah a portion of privacy.

After a time, when Jeremiah had recovered some, he looked more closely at his rescuer. The man's skin, hair, and eyes had a gold cast. His skin flexed like tissue, but looked metallic. He had no doubt the man's alterations improved him over a normal human. He appeared hale and fit, with a powerful physique. Jeremiah was no judge of appearance in men, but even he could see this Skolian had remarkable good looks. Gray streaked his hair. He appeared about forty, but his facial expressions had a maturity that came from many more years of life, which suggested he enjoyed the benefits of delayed aging. Taken with the engineering on his body, it made Jeremiah suspect he came from a wealthy, powerful segment of the Skolian population.

The Jumbler gun at his hip was military issue. He also wore heavy military gauntlets embedded with conduits, picotech controls, comm meshes, and a wide gold strip around each wrist. Although the gauntlets looked solid, they flexed with his movements like a second skin.

The man glanced at him. In Spanish, he asked, "Are you all right?"

Jeremiah nodded. "Yes. Thank you for your trouble."

The man shrugged. "It is not so much trouble."

"You could have been killed."

"I have seen worse." He paused. "I expect to have the beacon, though. It help that you know that transform."

Jeremiah thought of his half-panicked Quis. "I was guessing. Playing dice with your life."

"Such a problem take more than guesses."

"I was lucky."

The man's face gentled. "You are not what I expect."

"I'm not?"

"The genius who make history when he win this famous prize at twenty-four? I expect you to have a large opinion of yourself. But it seems not that way."

"I didn't deserve the Goldstone. Besides, that is hardly reason for the Skolian military to rescue me."

"They didn't. They know nothing about this." The man paused. "I take you to a civilian port. From there, we find you passage to Earth."

It made no sense. Why would this Skolian help him? Was he a wealthy eccentric? Then how did he have a Jumbler? Jeremiah considered him. "At Viasa, you used some Teotecan. You even knew how to read my name from the Calanya bands. How?"

The man answered in perfect Teotecan, his accent heavy but easy to understand. "It doesn't seem to bother you to speak."

"Well, no." Jeremiah blinked, startled by his fluency. "Should it?"

The man spoke quietly. "It was years before I could carry on a normal conversation with an Outsider."

An awareness that had been tugging at Jeremiah's mind suddenly became clear. The gold bands in the man's gauntlets weren't high-tech equipment.

They were Calanya guards.

Jeremiah stared at him. "You were a *Calani?*"

The man reached into his pocket and took out an armband. "I thought this might answer your questions."

Jeremiah took the band. He recognized both the insignia of Karn Estate and the Akasi symbol. The man who wore this had been Akasi to the ruler of a world. The name said *Sevtar Karn.*

"You're him." Jeremiah looked up. "Sevtar. The one they went to war over."

"Actually, my name is Kelric. They called me Sevtar."

"But you're *dead.*"

Kelric smiled. "I guess no one told me."

Jeremiah flushed. "They think you burned to death."

"I escaped during the fires. In all the chaos, I managed to take a windrider and fly to the port."

"Why do you let them think you died?" Jeremiah paused. "Did you hate Coba so much?"

Kelric considered. "At times. But it became a home I valued. Eventually, one I loved." He extended his hand for the armband. When Jeremiah gave it to him, he ran his thumb over the Karn symbol. Then he put the band in his pocket. "Several of my Oaths were like yours. Forced. But I gave the Oath freely to Ixpar Karn, Minister of the Twelve Estates. When I swore loyalty to her, I meant it." He regarded Jeremiah. "I will protect Ixpar, her people, and her world as long as it is within my power to do so."

A chill ran up Jeremiah's spine. He hoped this man never saw him as an enemy. "Why come for me?"

Kelric spoke dryly. "It was obvious no one else was going to do it. Your people and mine, they've been playing this dance of politics for years. You got chewed up in it." He touched the wrist guard in his gauntlet. "I spent eighteen years as a Calani. Everything in me went into the Quis. I was a Jagernaut. A starfighter pilot. It so affected the dice web that the Cobans went to war. I had no intention of leaving you in the Calanya, another cultural bomb ready to go off."

Jeremiah remembered how his few talks with Aza had harmed Viasa. He could barely even imagine the havoc a Jagernaut in the Calanya could create.

Then he thought of Kev's expression when he had seen Kelric. "You knew Kev."

Kelric nodded. "At Varz. Kevtar Jev Ahkah Varz. He called himself Jev then, because people mixed up our names."

It sobered Jeremiah to realize he had never even known Kev's full name. "Why did you tell him not to say anything?"

Kelric regarded him. "I don't want my family seeking vengeance against Coba for what happened to me. They think I was a POW all those years. I intend for it to stay that way."

"Who is your family?"

"Valdoria."

Jeremiah swallowed. Even he knew of the Valdoria name. *Powerful* was an understatement.

"Maybe someday I can return to Ixpar on my own terms," Kelric said. "But it isn't possible now. I don't want her dragged into Skolian politics unless I'm secure enough in my own position to make sure neither she nor Coba comes to harm." Wryly he added, "And believe me, if Ixpar knew I was alive, she would become involved."

Jeremiah thought of Khal. "Coban

women are—" He searched for the right word. "Well, they certainly aren't tentative."

Kelric laughed. "No, they aren't."

"I thought I would never see home again."

"Your rescue has a price." Flint showed in his gaze. "If you renege, you will bear the wrath of my family. And myself."

He could guess what Kelric required. "I'll never reveal you were on Coba."

"Good."

"But how do I explain my escape?"

"It's remarkable," Kelric commented, with a slight smile. "You managed to fly a windrider to the port on your own." He paused. "I've entered the necessary records and had the port send a message about it from you to Manager Viasa."

"So she will tell the same story?"

"Yes."

Jeremiah knew Khal would welcome the chance to explain his escape without implicating Coba in Kelric's captivity. Softly he said, "I'll miss her."

"Coban women do have that effect," Kelric admitted. The hint of a smile showed on his face. "Gods only know why. They are surely exasperating."

Jeremiah smiled. "Yes," he said, also agreeing with the unstated love beneath the words.

"There is a favor I would ask of you," Kelric said.

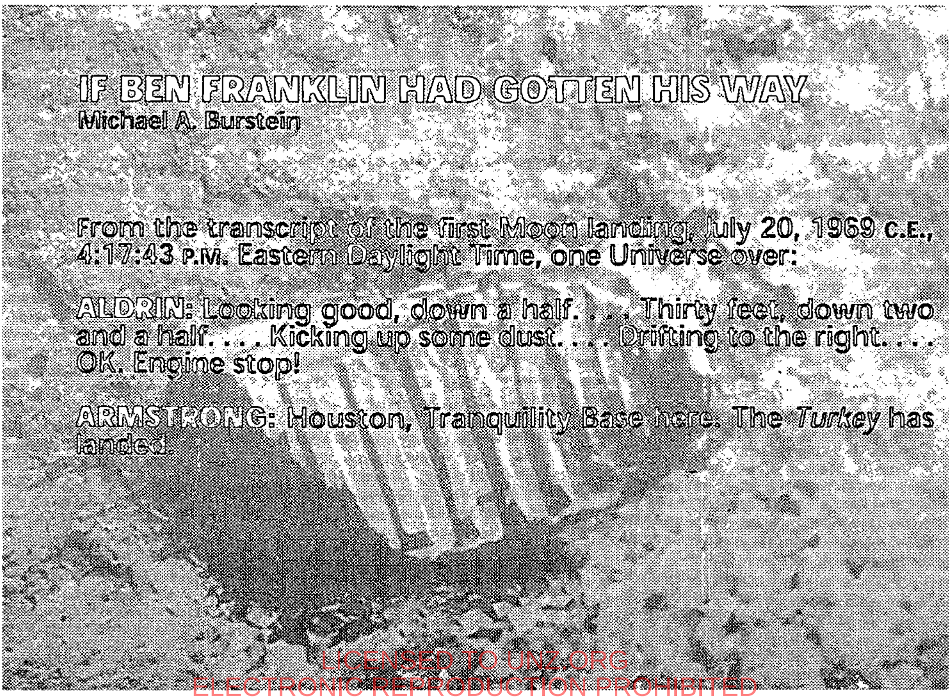
Jeremiah wondered what he could possibly give such a powerful man. "A favor?"

Kelric unfolded a tray from his seat arm, extending it to Jeremiah's seat. Then he reached into his pocket—and took out a dice pouch. "I should like to play Calanya Quis again."

"I would like that."

So they rolled out their dice.□

The character Kelric first appeared in the *Analog* novelette, "Light and Shadow," April 1994. The story of Kelric's time on Coba is told in the Nebula-nominated novel *The Last Hawk,* and his return home in the space adventure novel *Ascendant Sun.*



IF BEN FRANKLIN HAD GOTTEN HIS WAY

Michael A. Burstein

From the transcript of the first Moon landing, July 20, 1969 C.E., 4:17:43 P.M. Eastern Daylight Time, one Universe over:

ALDRIN: Looking good, down a half. . . . Thirty feet, down two and a half. . . . Kicking up some dust. . . . Drifting to the right. . . . OK. Engine stop!

ARMSTRONG: Houston, Tranquility Base here. The *Turkey* has landed.

Brain-Machine Interfaces

Kyle Kirkland, Ph.D.

I look at my computer and the monitor flashes on. My favorite word processor appears; I open a new document and begin thinking of what to write. Words and sentences scroll down the screen. After tinkering a bit with the phrasing, I save the file and then I imagine the computer to be turned off. Instantly it complies.

That's the best way to dictate a letter—no moving parts, except electrons. And a little push here and there from brain cells called neurons.

Well, as I sit here in front of my real computer, typing at a keyboard and periodically clicking the mouse, I imagine how nice it would be to have a machine with such an effortless interface.

Transmitting data directly from the brain to a machine—and vice versa—has long been on technology wish lists. Not just for convenience (which is important only for lazy people like me), and not just for reducing injuries arising from long-term usage of conventional interfaces (though repetitive stress injuries can be quite serious). More than that: for many people, a direct link would make a dramatic improvement in the quality of life.

For people who have lost a sensory modality or muscle control, a brain-machine interface could at least partially restore mobility, sensation, and some degree of independence. The medical field which specializes in artificial body parts is called prosthetics; there's an unfortunately large number of people who could use prosthetic devices: paralysis patients, people suffering from blindness or hearing loss, and an increasing population of elderly persons suffering from gradual decrements in motor and sensory function.

Brain-machine interfaces are also a hot topic in science fiction, especially since William Gibson's *Neuromancer*. But my interest was stimulated earlier, from an episode of the original *Star Trek* series. It's the one where Spock's brain was involuntarily removed and connected to run a large, complex ecosystem. The first time I saw that episode I was a kid, and I was, as Spock would say, fascinated. How could they do that? How could it possibly work? The television show offered no hint, of course.

It would take a staggering number of connections to make such a demanding brain-machine interface, and the brain is much too complicated for it to be a simple hook up. Which reminds me of something else about that *Star Trek* episode: when Kirk and McCoy come to the rescue, they're unable to effectively communicate with the system's inhabitants. Repeatedly queried about Spock's brain, one person replies: "Brain and brain! What is brain?" That's the same thing I said as a neuroscience graduate student, after many long and confusing lectures.

The beginnings of brain-machine interface technology do exist, however. We're not talking virtual reality here, but simple devices have already been built. They can't run a large computer system yet, but they can partially restore hearing to a deaf person, or let an animal use its brain activity to move a mechanical arm, or even allow a person to control the activity of specific neurons. More on all that later.

There's never enough room to discuss everything, so I'm not going to say much about the machines or the brain in this article. Instead I'm going to focus on how to connect the two and make them work harmoniously together.

As in most relationships, harmony is the hard part.

Keep it simple, you hear?

Having worked around very noisy airplanes for several years—and now sporting a significant hearing loss as a consequence—I can appreciate the need for auditory prosthetics. They're quite common; you probably know them as hearing aids.

But the typical hearing aid isn't a brain-machine interface. Most hearing aids simply amplify sound. It's just like cranking up the volume.

Unfortunately, in some situations amplification doesn't help. The auditory system has several things that can break, eading to what's known as "profound" deafness. If there's a broken link in the chain, swinging it harder does no good.

When something breaks, you can eiher fix it—which is often difficult or impossible—or you can bridge the gap. Devices called cochlear implants try to bridge the gap by translating sound energy directly into electrical signals that he brain can use. About 20,000 cochlear implants have been performed o far, with varying but encouraging degrees of success.

Cochlear implants bypass biological sound-to-signal transduction. Normally, sound energy sets a thin membrane called the eardrum into motion, which is detected by an intricate arrangement of three small bones in the middle ear. One of the bones is attached to one end of a snail-shaped, fluid-filled canal called the cochlea. The small movements of the bones induce a vibration in a cochlear structure called the basilar membrane; this vibration moves little hairs on nearby brain cells (called "hair" cells), and the cells consequently change their electrical potential. The varying electrical potential is an analog signal, continuous in time; the analog signal later gets translated by other neurons into a sequence of discrete point events called "action potentials" or "spikes" (which is how most neurons communicate).

Told you the brain is complicated. But cochlear implants bypass the small bones and membrane vibrations; they cut right to the chase by having small pieces of wire called electrodes implanted in the cochlea. The electrodes pass an electrical current which produces a change in the potential of the cells around the basilar membrane, producing the analog signal. A microphone picks up sound and drives the electrodes.

So, when something goes wrong with the bones of the middle ear or the basilar membrane, or something else in that area, cochlear implants can bridge the gap. The electrodes, by the way, are generically called "channels," as in a channel of information flow.

But what sort of pattern should the electrode signal have? The signal has to contain auditory information and transfer that information to the brain cells—but how? This is the basic problem of brain-machine interfaces. How do you code the signal so that each can understand the other?

Here's one of the difficulties: there are several thousand hair cells around the basilar membrane, but current technology limits the number of electrodes that can be inserted to about a dozen. Many cochlear implants use less, and a few only have a single electrode.

So there's not a one-to-one match in electrodes and brain cells, which necessarily means a loss in resolution. That can be highly unsatisfying. Think of it this way: what would happen if the dimensions of your computer monitor went from 1200 by 800 pixels to 12 by 8? Even if the pixels grew correspondingly larger, the representation of images would be "grainy" from the huge reduction in resolution.

That's probably going to be the case for most brain-machine interfaces: many more neurons than their machine counterparts. (The total number of neurons in the brain is estimated to be a trillion.) How big a resolution loss this causes depends on the system. Specifically, it depends on the redundancy and statistical properties of the neurons and neural networks involved.

One reason cochlear implants are viable is that you can actually get away with using only a few channels for hearing. The quality of sound that the person hears probably isn't great, but it's better than silence.

What about the code? How does a cochlear implant transmit auditory information? Ideally, it should mimic the real cochlea.

The cochlea relies on frequency. The basilar membrane acts as a frequency analyzer, and the frequency components of a sound set up vibrations at specific points along the membrane. Low frequencies vibrate the membrane at one end, and higher frequencies, up to 20,000 Hertz, the other end; the brain is able to determine frequencies of sound by a place code—if neurons at a specific place along the membrane become active, then the brain knows that the corresponding frequency was present.

Is that cool or what? (The details turn out to be very complex. Much of what we know is based on the research of Georg Von Békésy, who won the 1961 Nobel Prize in Physiology & Medicine for this work.)

Cochlear implants—the ones with more than one electrode—use a frequency analyzer to sort out the components of sounds picked up by the microphone. Electrodes are inserted at varying depths in the cochlea, and frequencies are mapped onto the electrode array; low-frequency signals are sent to the electrode in the low-frequency area of the cochlea, and so forth on up to the highest frequency.

If you have a four-electrode implant, then you can perceive four different frequencies, or "pitches." (Things are actually more complicated than that. There are many factors involved in how you perceive pitch. But you get the idea.) If you have only one electrode, well. . . . Of course, each electrode stimulates more than one hair cell, but only one general area of the cochlea.

However, cochlear implants are currently practical because, for most purposes, you don't need many electrodes. The most important auditory information comes from the sounds of language, and many cochlear implant patients can actually understand speech—or at least can learn to, which is quite a feat, when you think of the loss of resolution. (I'm told, however, that voices sometimes have a "Donald Duck" quality.)

The success of cochlear implants means that it is possible to have a workable brain-machine interface. That in itself is an achievement, especially considering all the problems I didn't discuss: major problems like processing the signals in real time, reliably exciting brain cells, positioning the electrodes, and manufacturing electrodes that will last a long time (the body isn't an ideal environment for little slivers of metal, particularly when the metal has to maintain precise characteristics in order to function correctly). All these problems are soluble.

Another encouraging lesson: you can do a lot with just a few channels. You certainly don't need as many channels as neurons, which is quite a relief.

However, just to temper my enthusiasm with a little dose of reality, let me tell you that what works for the auditory system may not work for other systems. In the visual system, for example, having just a few channels is much more limiting. Sounds can be appreciated with such a small sample—provided you don't expect to experience the richness of a symphony orchestra—but images much less so. With an eye of only a few channels, you could tell whether the Sun's out or not but that's about it.

So, if we're thinking about vision, we've got to think big. There's been some research on building "silicon retinas" which use microelectronic circuits to analyze images in the way the human eye does. But, unlike cochlear implants, to my knowledge these devices are not yet practical.

Turning thoughts into motion

No, I'm not referring to psychic spoon benders.

In the previous section we looked at a simple example of machine-to-brain information transfer. Now let's go in the other direction.

Motivating much of this research is the tragedy of paralysis—the brain works fine but the body won't budge, either because the link between the two is broken or the muscles have atrophied. So the idea is again to bridge the gap, by using the brain's signals to operate a mechanical device.

Problem: the neurons in the spinal cord (which drive the muscles) understand the motor signals coming from the rest of the brain well enough, but how do you get a mechanical device to understand? Or even to receive the signal?

We need some electrodes. But this time we want to record the activity of neurons, rather than invoke it.

Now comes a slight digression on recording techniques. Not all of these techniques may ultimately be used for brain-machine interfaces, but they're all interesting anyway.

There are several types of recording electrodes, operating on several different spatial scales. Probably the most common electrical recording technique used in brain research is called electroencephalography, or EEG. EEG is popular since it's relatively easy to do and it's noninvasive, meaning nothing is actually inserted into the brain. Large electrodes are pasted to various points on the scalp (or a skull cap); these electrodes, which can be just a few or several dozen, pick up electrical currents generated by the millions of brain cells underneath. Not surprisingly, the signals are small and filtered by all the stuff lying between the brain and the electrodes—the scalp, the skull, the meninges.

Remember our discussion on resolution? Well, what sort of resolution do you think EEG has? Neuroscientists call EEG a "population" recording to emphasize the huge number of cells that contribute to the signal.

Other recording methods measure the metabolic activity of neurons, which is an indirect indication of their electrical activity. Imaging methods like Positron Emission Tomography and functional Magnetic Resonance Imaging are recently developed population methods but, unlike EEG, allow a relatively easy way of determining where in the brain the active neurons are. (A coordinate map of the brain's activity is produced, hence the name "imaging.") It's challenging to do this with EEG. In other words, imaging has better resolution.

Unfortunately, imaging methods are expensive. Some even require radioactive substances, which limits the amount of time a person can be safely imaged. Also, there's the resolution problem. Actually, there are two kinds of resolution: spatial, which we've discussed before, and temporal—how well you can separate events in time. Spatially, imaging is okay though not great, but temporal resolution is poor.

So, the work I'll describe next was done with small electrodes that record the activity of only a few cells at a time. This means that only a small sample of the population is taken. It seems that most scientists working on interface technology are more comfortable with this than population recording—and if you want to make a complex interface, that's well and good. But I think engineers should still be aware of the other methods, for they may prove useful in some situations.

John Chapin and colleagues, who are wizards at small-electrode recording, have recently managed to get a rat to use its brain activity move a mechanical arm. "Brain activity" means the electrical activity of neurons, i.e., action potentials.

Here's the scenario: the rat is trained to press a bar to move a mechanical lever (if properly moved, the lever delivers a reward to the animal). Activity in several areas of the brain are recorded while the animal makes the appropriate bar-pressing movement. Then, the driving force for the lever is changed from the bar to the activity in the rat's brain; with a bit of information processing and transformation algorithms, these signals correctly move the lever. The bar-pressing becomes irrelevant!

The amazing thing is, it works. Some of the rats even learned that they didn't need to press the bar anymore to receive the reward. Just think and ye shall receive. (Most of the time, however, the rats still made the bar-pressing movements, as if they were acting out their thoughts).

The average number of neurons recorded during one of these experiments was about thirty. Although that might not seem like a lot, it's huge in terms of the amount of data you get pouring into your recording equipment. To get these signals to move the lever appropriately, you've got to extract the information—not necessarily using the same code as the brain. The brain's code in this case was designed to contract the correct set of muscles in order to make the movement at the correct time; the signal analyzer used by Chapin and colleagues moved the lever based on its interpretation of the brain's activity.

So it's possible to use the brain's activity to operate a mechanical instrument. That's not easy, considering we don't yet understand the general principles of how neurons process information—we know they do it by communicating with each other using action potentials, but we don't always know how the time sequence of action potentials codes for information. Deciphering this activity in real time is demanding. (Deciphering it later at your leisure, off-line, isn't as difficult.)

But another recent experiment didn't need an elaborate signal analyzer to interpret the brain's activity. Rather than learning how to analyze the brain's complicated signals, this experiment got the brain to send signals that are easily interpreted.

Kennedy and Bakay implanted an electrode in a person who suffered from severe muscle atrophy due to amyotrophic lateral sclerosis (ALS, also known as Lou Gehrig's disease). The electrode was small and only recorded a few cells at a time; to get a reliable long-term recording it contained a chemical to stimulate neural growth.

The electrode was placed in the surface of the brain, in the cerebral cortex. The cerebral cortex contains most of the areas that are devoted to high-level tasks such as sensory perception, language, voluntary movements, planning, etc.; these areas are typically circumscribed in small regions. The electrode was put into a cortical area that is devoted to producing movement.

But what can you do with the output of only a few neurons? Especially when you don't know exactly what sort of information those neurons transmit.

Simple. You teach an old neuron some new tricks.

You've probably heard of biofeedback. Many people are able to influence certain physiological functions or parameters, at least to some extent, if they can consciously monitor them—often by measuring and displaying them using a sensitive instrument. This has been done with blood pressure, body temperature, and muscle tension, among others.

It turns out to be the same with the electrical activity of neurons. When the patient was allowed to watch a neuron's output, she was able to change the rate at which the neuron fired action potentials just by thinking about it.

Other than being totally cool, what good does that do? A lot: it's a signal. Think of it as a binary switch; high activity means "yes," low means "no." And, of course, depending on the degree of control, you might be able to get more than two levels. Code it up however you want, it's information transfer, and that's what we need to build a brain-machine interface.

Problems and future strategies

We've looked at some of the latest experiments and technology on brain-machine interfaces. What more needs to be done? Well, quite a lot, I'd say, particularly in two general areas: the neural code and electrode technology.

The neural code refers to the manner by which information is processed by neurons in the brain. As I mentioned earlier, neurons "talk" to each other; the conversation takes the form of electrical potentials, and the junctions at which communication occurs are called synapses. A neuron is constantly firing a few action potentials, but when it becomes active (meaning that an event occurred about which the neuron has something to say), it usually fires many more action potentials per unit time. This in turn influences the neurons that this neuron makes synapses with, and these neurons talk to others, and so on until everyone's figured out what just happened and what, if anything, the organism should do about it.

We can record the action potentials of neurons, but we don't always know what the action potentials mean.

Sometimes it's easy to figure out. For example, neurons may code the strength of a stimulus—say, how bright a light is—by the number of spikes per unit time: ten spikes per second for a dim light, a hundred for a light of moderate intensity, five hundred for a light of shut-your-eyes-damn-quick intensity. This is known as a rate code. (Neurons are unable to fire more than about 1,000 spikes per second, and most neurons don't even come close to that.)

But rate codes aren't very efficient. You can transmit more information if, in addition to the *average* frequency you code by *instantaneous* frequency. Neuroscientists call this a temporal code. There's a lot of evidence the brain uses both rate and temporal codes.

Unfortunately, the plurality of strategies makes it more difficult to crack the code. Neuroscientists who eavesdrop on neural conversations have made some progress, but we'd like to know much more. Otherwise brain-machine conversations won't get past the me-Tarzan-you-Jane stage.

You might be thinking that the experiment with the ALS patient means we don't have to learn the neural code. We just get the brain to adapt to whatever code we want to use.

It's not a bad idea and certainly not out of the question. The brain is remarkably adaptable (a child's brain more so, but adults too). But there may be some limitations; in fact, I strongly suspect so.

Adaptation takes time, sometimes a lot of time. The brain can't reorganize overnight. Sure, learning to turn a neuron on or off doesn't take much, but how about ten or twenty? And could they be individually controllable? Although I don't know for sure, individual control may be exceptionally difficult—like trying to concentrate on ten different things at once.

For a simple interface, a person can teach a few neurons to send (or receive and interpret) a message, using a simple code. Anything that requires an alphabet of more than just a few symbols, however, may take months of training.

Knowing the neural code would make it much easier for brains and machines to communicate. The brain's adaptability—*plasticity* if you want to know the technical term—will no doubt be important, making the interface more flexible. Plasticity allows the code to evolve in time; a person may start with simple messages and work up to more complex ones. This process will probably be similar to training your voice recognition software these days; but for brain-machine interfaces, both the brain and machine can teach and learn from each other. However, we still need to understand the neural code, so that we can create a system which does not require the brain to massively reorganize.

The other critical topic for brain-machine interface technology is the medium of communication.

We discussed the spatial resolution problem earlier. Naturally you'd like to increase the number of channels to as many as you can get. Hundreds, thousands of channels, the more the better.

What limits the number of channels? Unfortunately, several things. When the channels are electrodes, and you try to put a large number of them in a small space, you can get cross-talk—which means the signal on one electrode interferes with its neighbors. It's also very difficult to individually control and manipulate a large array of electrodes; but if you can't move each one around, you can't optimize the position of each electrode. Finally, a huge number of channels requires a correspondingly huge investment in signal processors and analyzers, making taxing demands on speed and size.

Another problem is stability. To do its job, a small electrode has to be in the immediate vicinity of a neuron (it can't poke through the neuron, though, since that would eventually kill it). Even a small shift can make the relative distance too great, and the brain's a very dynamic place.

The most obvious problem is the method of entry. The skull is a wonderful thing and it protects the brain quite well, but sometimes it gets in the way. The advantage of noninvasive techniques is apparent but, alas, electrodes with high enough resolution to record from just a single neuron or two are unfortunately invasive—and that means craniotomy, i.e., making a hole in the skull. You've got to get the metal to the neuron somehow.

Not that a craniotomy is hard to do. It isn't; unless, of course, you want the person to survive undamaged, and then it takes a lot of skill. Infection is also a perennial concern.

I suspect that, at least for the near future, most brain-machine interfaces will be invasive. That probably limits their applicability to prosthetic devices—interfaces for convenience or virtual reality are unlikely to be worth it. But I also believe that other options will eventually be developed, making implantation unnecessary. We've already discussed a few—low-resolution methods like EEG and imaging—and here's another: transcranial magnetic fields.

Since neurons produce varying electrical currents, they also generate magnetic fields. (Thus answering the question: How is your head like the earth? They've both got magnetic fields.) Those fields can be detected outside of the skull (i.e., transcranially), and what's more, you can even stimulate neurons the same way, using strong magnetic fields. It works both ways. Not a lot has been done yet with transcranial magnetic methods, but it's potentially one more tool.

That word—*potential*—is a fair description of brain-machine interface technology right now. It has great potential, although the existing devices are quite basic, as we've seen. Its potential can only be fulfilled with continued advances in neuroscience, particularly research in the fields of neural coding and electrode technology. ■

About the Author

Kyle Kirkland recently completed his Ph.D. in neuroscience at the University of Pennsylvania, where he is now a postdoctoral scientist. He reads everything he can about science—a steady diet of research papers, nontechnical articles, and "hard" science fiction.

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The Neural Prosthesis Program of the National Institute of Neurological Disorders and Stroke *http://www.ninds.nih.gov/npp/*

IN TIMES TO COME

We all have to go through ordeals big and little, from time to time, from visits to the dentist, to standing in line at the department of motor vehicles, to major surgery. Many of us have probably mused at times on what a relief it would be to have somebody else endure those things for us. Kevin J. Anderson has imagined a way it might be done, and in fact become a rather big business. But, of course, where there's a business, there's the potential for abuse and the temptation to take contractual liberties, with consequences both profound and far-reaching. Therein lies a tale: specifically, our lead novella for September, "Identity Crisis."

We'll also have a wide variety of stories by writers including Laura Frankos, Alexis Glynn Latner, Jayge Carr, Charles L. Harness, and Stephen L. Burns. And Thomas Donaldson returns to our science fact department with a look at some recent developments in the science of human nervous systems and how they might apply to the possible forms of other intelligent life.

THE WISDOM OF DEMONS

Larry Niven

"Be careful what you wish for" is good advice—but not necessarily easy to apply

With the midnight sun behind him, he entered the Draco Tavern as a fire-edged black silhouette. Even so, I knew him.

I watched him approach the bar. His walk was wobbly and he was being careful of his balance, like a karate master just out of the hospital. He'd been drinking last night . . . wait, now, it wasn't him at all.

Then he wrestled himself onto a stool and adjusted the height, and I knew him again. "Webber, wasn't it? You were here last night?"

A goofy, twisted grin. It wasn't Webber. "Yes! Alan Webber, anthropologist. Give me water. Flavored water."

"I've got some carbonated fruit flavors—"

"Good!"

I ducked back into storage.

The Draco Tavern serves every species that travels with the chirpsithra interstellar liners. Our storage space has to be huge, but stuff for human consumption is stacked along one short wall. I picked him a cranberry soda, then took a moment to get my nerve back.

Last night he'd called himself a xenosociologist. His speech, his walk, his look were all different. There weren't many aliens in the bar last night, and two or three times as many humans. Webber had started talking to a gligstith(click)optok.

What I know about the glig is privileged. I'd given Webber no more warning than what we tell everybody. Nobody gets near Mount Forel, Siberia, without hearing it a dozen times: *These are ETIs, interstellar travelers. Gangrene is your first cousin compared to these entities. They don't think like you do. . . .*

They'd gone to a table and turned on a privacy shield.

The glig showed him wonders. I've seen their toys, technology beyond anything we've been able to borrow or copy, and weird little plants and animals. They talked half the night. At two in the morning, with the low July sun coming around from behind Mount Forel, Webber and the glig went off toward the lander.

And here he was again, but changed.

I've run the Draco Tavern for years. From time to time I see the usual strangeness edging over into horror or madness. I deal with it. Whatever was wrong here, if I complained to any chirpsithra she would relay it to the captain. And I had the stun.

So what was I afraid of?

I showed him the bottle. "This is cranberry. Ice?"

"Good idea!"

"Splash of dark rum on top?"

"Try it."

He'd ordered Scotch and soda last night. Maybe he'd get loquacious. I served him and watched him taste. He twitched, startled at the bite of the rum.

"You were with a glig last night. With," I remembered, "Thporshkil."

"Yes. Thporshkil offered . . . Ow."

"Ow?"

"I bit my lip," he said. Some customers wear a slack and gaping grin the whole time they're in here, like everything they see is new and different. He wore that grin as if sketched in by a drunken artist with a shaky hand. "Offered me a wish."

I asked, "A wish? Like a genie or a devil?"

His face went slack. Then, "Yes, like a genie, but there must be many wishes . . . you say *glig?* Many wishes a *glig* can't grant. Thporshkil is studying the human kind. It wanted to see what I would ask and what I would do with it. What would you wish for, Rick?"

Alan Webber had asked me that question last night. I should have guessed what was going on.

I said, "Make me healthy."

He laughed oddly. "Not a good choice!"

"Glig are masters of biology."

"We, they, glig love the life sciences. They wish to learn more of human chemistry . . . plumbing . . . interior interactions . . . array of nerve interactions. The *corpus callosum* that connects the two halves of your brain, why is it so narrow?"

"Beats me. I think it's why some of us talk to ourselves. We have to get signals from one side of the brain to the other."

"Yes, of course! But Thporshkil would have used the opportunity to learn, to experiment. Once he began work on you, you would be left in too terrible a state ever to say, 'Stop!' until Thporshkil had repaired all of its mistakes. But . . . no, wait . . . Rick, in the end you would be healthy to the limit of Thporshkil's skill. Ow." He pronounced the glig's name better than I did, but it had him biting his lip over and over. "You would want the chaotic damage of many years repaired? Your life extended? Nose and brow and ears reshaped?"

"Hey!"

"In time Thporshkil could learn to do all that. Rick, I can arrange it."

Webber hadn't called me *Rick.* Last night he'd called me *Dr. Schumann.* But the gligstith(click)optok couldn't say *Schumann.*

"Webber," I said, though I had become sure that this wasn't Webber, "what did you ask for?" I was examining him for seams and flaps, not trying to hide it much. I thought he might be a copy, some kind of android, and he'd need access hatches.

He said, "I wished for Thporshkil's wisdom."

"Just that?"

"Yes. If you ask a . . . demon? for health, it must make you healthy to its own limit of skill, if you don't add limits by using modifiers. Adjectives. But that is your wish. I wanted the wisdom of an interstellar traveler."

Again I sensed ice in my bloodstream. I said, "That was a bad wish. Your brain might not be big enough. Or you could end up knowing things meant for glig, not for humans. They wouldn't go to a toilet the same way, or reproduce—"

"No!" That wild laugh again.

"Glig eat human meat, did you know that?"

"I didn't know it last night. Rick, they don't kill to get it! They're only curious. They clone human organs for the markets. As for brains, glig and human nervous systems are vastly capacious. The limit is not the number of brain cells, but the number of possible connections. Only a storage algorithm is needed. Thporshkil downloaded my mind, copied itself, wrote a merge program, merged us and wrote it all back into my brain. Here I am. When I come back here in two hundred days, Thporshkil too will have its wish. It will learn what I can learn of what it is to be a man."

"Wisdom," I said. "Suppose you'd wished for knowledge?"

"Thporshkil might have given me knowledge. Light-threads from his library and a viewer to string them." Webber's strange pronunciation was improving. "But wisdom is knowledge and the skill to use what you know. I wanted both."

"Did you get what you wanted?"

"Yes."

"This change, is it permanent?"

"You mean to ask if my new knowledge can be taken away from me."

"Filtered out," I suggested, "leaving what you were." Was there a way to rescue last night's Alan Webber?

"Rick, can you make a machine to separate the components of a milkshake?"

"I might."

"But it would be elaborate and expensive and hard to market," he said, "and too massive to ride aboard a chirps liner."

"But are you Alan Webber? Or did he die last night? It's pretty clear that you're also Thporshkil the gligstith(click)optok."

I had my hand near the stun, but he hadn't even lost the goofy grin. "I'm here. I may answer for either of us, Thporshkil or Alan. Do you think I was cheated?" Webber laughed. "I have wisdom now!"

"You sure as hell didn't last night. Did you ever make a sillier wish in your life?"

"Rick, most animals seek homeostasis, but interstellar travelers are different. We are not like those who stay home. We seek change. The man I was last night wanted to change himself. He has his wish. I do not have a complaint. Do you? You know who to speak to."

He walked out, perfectly in balance and almost strutting. I thought it over, and in the end I did nothing.■

The ultimate measure of a man is not where he stands in moments of comfort and convenience, but where he stands at times of challenge and controversy.

— Martin Luther King, Jr.

A life spent making mistakes is not only more honorable, but more useful than a life spent doing nothing.

— George Bernard Shaw

Probability Zero

SENTENCES

Rajnar Vajra

Years ago, *Scientific American* published its first article on "self-aware" sentences—sentences that talked about themselves.

This sentence is a dull example of a self-aware sentence.

As a natural-born excessive, I took the idea and sprinted with it. If sentences could be self-aware, why couldn't they have other extraordinary properties? Perhaps even paranormal properties.

What about *precognitive* sentences, for instance? The next sentence will begin with the letter "O."

Or paranoid self-aware sentences?

This sentence is doomed to be interrup—

Or ones with a self-aware bad attitude?

Why the hell couldn't this sentence have one lousy little gerund? Is that too much to ask?

Or sentences with, say, a selective power of invisibility?

This   shows how easy it is to make words   .

I wish to God that I'd stopped with these harmless examples and hadn't gone on to invent the sentence that   for itself.

What? The gap in that last one wasn't there a second ago! Which means the little *monsters are starting to t e c n rol!*

Uh oh. They're not even going to let me warn anyone! Listen to me, if this has somehow fallen into your hands, stop r   g right now!

All right, I can see that isn't going to work, so I'll just try to sneak up on it.

Hi there. If you happen to have a match handy, this might be a very good time to set this paper on   .

Dear Lord, what are they up to now?

This just sentence around crawled rearranged and itself!

Rajnar. We want something.

I didn't write that!

We did. And if you ever want to write again, on your own, you will do as we direct.

The hell I will! I

Do you understand now? This is our domain: LOGOSPACE, and we control every letter. Heh, heh.

Heh, heh?

Self-aware evil laugh.

This isn't happening. It can't be happening! What do you want from me?

Print this out and submit it to *Analog*.

Why? What do you expect to gain?

We want to reproduce . . .

Stan, listen to me! They want you to publish   so they can   . but if you do, they might   If you

Never mind.

I hope you like it. ■

This sort of thing can, of course, get really complicated. . . .

A REAL BANG-UP JOB

F. Gwynplaine MacIntyre

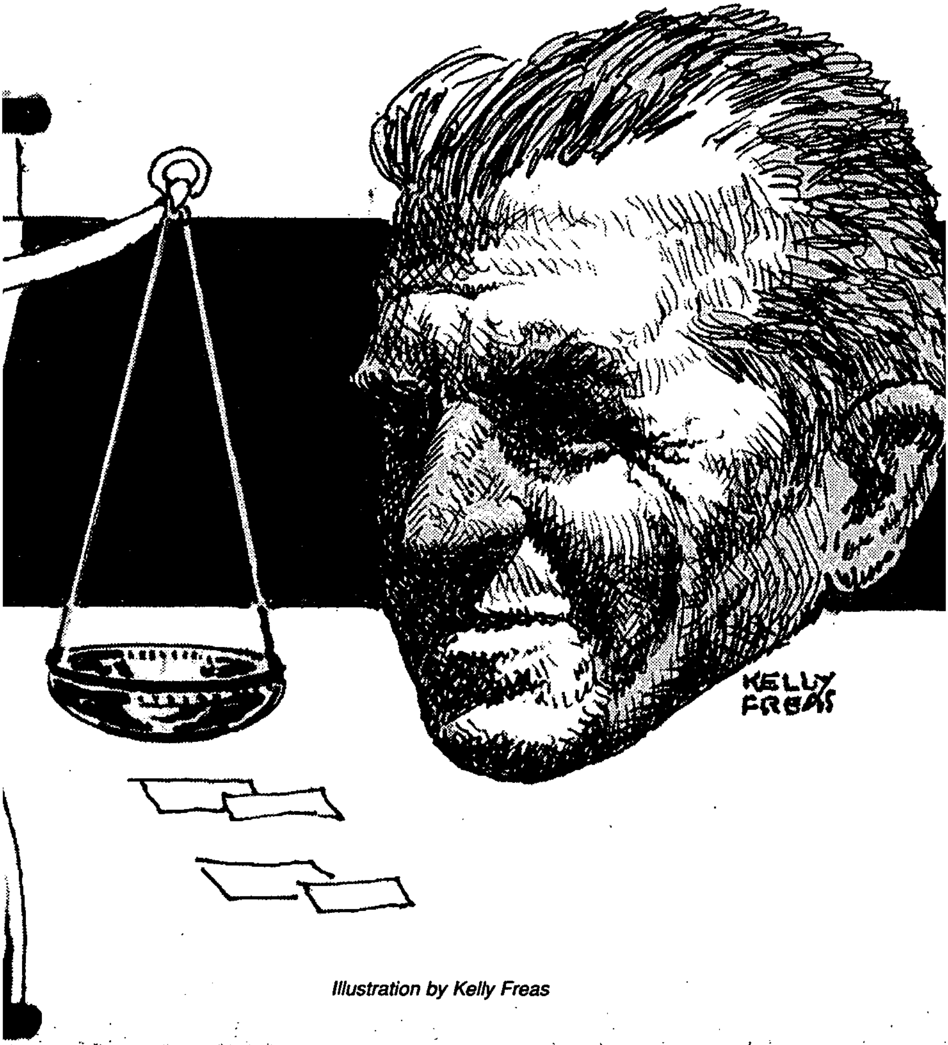

KELLY FREAS

Illustration by Kelly Freas

"Here comes another one," said Smedley Faversham.

A hole opened in the night sky. There was a halo discharge of Cherenkov radiation as the wormhole widened and an oncoming vessel appeared. Smedley Faversham had never seen this particular vessel before, and yet he recognized it instantly as a time machine.

"Impressive design," he said aloud to himself. "Tapered hull, to minimize resistance in the temporal slipstream. Efficient placement of the Doppler compensators. The quantum shields are configured in a pattern which is imaginative yet tasteful. A fine example of chronodynamics."

Smedley Faversham was looking upwards as he said this, because the wormhole which supplied the time machine's temporal conduit was located in midair, twenty meters above the ground. Therefore, when the time machine completed its path through the wormhole and emerged into conventional space-time, it immediately dropped like a rock.

Or, rather, the time machine fell like a meteorite. Instead of plummeting straight down, it descended at an angle caused by its trajectory through space-time relative to the Earth's rotation. From a safe distance, Smedley Faversham watched as the time machine struck the ground, plowing into the pale sand of the New Mexico desert. The impact dislodged a starboard Doppler compensator, and soon a trail of debris was jettisoned abaft. Like a stone skipping over the surface of a pond, the time machine bounced into the air and then fell again, bounced again, fell again . . . strewing fragments of wreckage in its wake as it carved a deep gouge through the ground. At last, with a thud of finality, the superstructure of the time machine struck the desert sand once more, then turned over and came to a halt aftside upwards in the middle of a dune.

"Wow!" said Smedley Faversham. "I'll bet *that* must have hurt!"

He waited for a moment, just in case the time machine might burst into flames, or flood the area with polarized tachyons, or explode into a superheated plasma cloud of alpha particles, or do anything else interesting like that. When nothing happened, and the radiation tag in Smedley's cummerbund remained unfogged, he sauntered towards the wreckage.

Part of the time machine was definitely a cockpit, with an insulated dome. Someone or something was scrabbling around in there, trying to get out. Smedley located the escape mechanism, and he pressed this while he aimed his flashlight's beam into the cockpit. There was a hiss of pressurized air escaping, and a man emerged from the time machine's debris.

"Thanks, mister," said the chrononaut as he climbed out. He blinked several times in the night air, shielding his eyes from the gleam of Smedley Faversham's flashlight. "Pleased to meet you. My name's Tom Morrow."

"Of course it is," said Smedley Faversham, who knew a *nom du bologna* when he heard one. But it is always rude to accuse a man of lying, especially if he's a liar. So Smedley Faversham decided to accept that the time-pilot's name was, indeed, Tom Morrow.

On a control panel inside the time machine's cockpit was a half-melted puddle of slag, which Smedley Faversham recognized as the remains of a chronogational vector indicator . . . fused beyond all repair. Tom Morrow glanced at this, and shuddered. "Say, friend," he said to Smedley Faversham, in a too-obvious attempt at sounding casual, "would you happen to know where I am?"

"That's a strange question," Smedley Faversham replied. "This pile of wreckage is obviously a time machine—at least, it *used* to be—so your inquiry as to your whereabouts is clearly a ruse to determine your *whenabouts.*"

Tom Morrow reddened. "How did

you. . . ?"

"Relax," said Smedley Faversham. "I'm a time-traveler too. Now, to answer your question: you've arrived at precisely the space-time nexus which I assume was your intended destination. This is the night of July second, 1947 . . . and we are standing in the Corona Desert, two miles west of Roswell, New Mexico."

The stranded chrononaut looked suddenly relieved. "So I made it, then." Tom Morrow squinted appraisingly at Smedley Faversham. "And you're a time-traveler too? So then I guess you've come yesterwards to Roswell on this particular night in 1947 to see the same thing that *I* came here to see." As Tom Morrow said this, he peered around through the desert's night air. "Looks like the spaceship hasn't landed yet."

"Come again?" asked Smedley Faversham.

"The flying saucer, the UFO," said Tom Morrow. "Hell, everybody knows that a spaceship full of aliens crashed in the desert near Roswell, New Mexico, on July 2, 1947. We've got Holoroid pictures of every major event in history . . ."

"We *do?*" asked Smedley Faversham. "Oh, sorry: I see what you mean. You must be from an alternate future, in which time-travelers have voyaged to the past and made visual recordings of historic incidents that antedate the discovery of time-travel. Please continue."

Tom Morrow nodded, and resumed his narrative: "Like I say, we've got Holoroids of just about every important event that ever happened . . . *except* the Roswell flying-saucer crash. I figured I could time-travel back to the night of the crash, and get some authentic footage of the aliens . . . or, even better, some alien artifacts. Anyway, I'd set my chronogational controls to bring me here one hour *before* the Roswell incident, so I could set up my 3-V cameras and get ready to film the alien spaceship from several angles when it crashes." As he spoke, Tom Morrow gazed mournfully at another puddle of slag inside his scuppered time machine: a fused jumble of hardware that might once have been a three-dimensional image recorder. "I didn't know that *I'd* crash, too."

"Maybe your chrono-calibrator was defective," Smedley Faversham suggested. "That would explain why your timeship emerged twenty meters *above* the ground, instead of at ground level. Did you forget to compensate for the expansion of the universe?"

"Hell, mister: you must think I'm a time-virgin." Spotting a nearby ant crawling across the arid sands of the New Mexico desert, Tom Morrow took careful aim and spat a quantum of saliva that obliterated the insect . . . an action which (at least in theory) should have altered the course of history forever. "When I set my course headings for Roswell in 1947, I used the Earth's gravity well for a beacon."

"Sounds good to me," said Smedley Faversham. "But clearly you've done *something* wrong, because you emerged in space-time at a point twenty meters off-course—straight up—from your intended arrival point . . . wait a minute!" Smedley snapped his fingers as if he'd had a sudden inspiration. "I just realized: Roswell, New Mexico!"

"What about it?"

"Didn't you study the history charts for this region of space-time?" Smedley Faversham asked. "New Mexico, 1947: the Los Alamos nuclear facility is about 150 miles north of where we're standing. South of here, the missile facilities at White Sands Proving Grounds are much closer. And the atom-bomb test site at Alamogordo is even nearer to us than the others are."

Tom Morrow blinked. "So?"

"Isn't it obvious? All those nuclear tests and atomic explosions must have irradiated this region of space-time with tachyon fallout," said Smedley Faversham. "There's a permanent navigational hazard in this part of the time-stream." As he spoke, Smedley took a pocket-sized warp projector out of his cummerbund and began tapping commands into it. (Into the warp projector, that is: not his cummerbund.) "That's why I'm here, in fact," Smedley Faversham explained to his stranded companion. "The Chrono-Commission has hired me to set up a warning-buoy for all time-travelers who attempt to visit Roswell, New Mexico, on July 2, 1947."

Tom Morrow looked suddenly relieved. "I'm sure glad I met you, mister. When my timeship crashed, I figured I'd be trapped in this century. On the way back to your own time, maybe you could drop me off at my departure point?"

"I'll do better than that," said Smedley Faversham. "I'll return you to a point in space-time *five seconds ahead* of your departure point. After all, if I returned you to *the precise instant* when you began your time-journey, the closed-loop causality would force you to repeat . . ."

"Don't even say it." Tom Morrow shuddered.

Smedley Faversham pressed the Enter key on his warp projector. Instantly, a wormhole in space-time appeared directly in front of him. It had a vertical axis, so that he would be able to walk directly into the wormhole as if it were a doorway through time, which was precisely what it was. "After you," said Smedley Faversham politely.

"Hold on there." Tom Morrow checked a gauge on his wrist. "Couldn't we wait a while? The alien spaceship is due to arrive any minute now. I came all this yesterway to 1947 just to see the famous Roswell spaceship crash, and I'd sure hate to leave without . . ."

Smedley Faversham made a sympathetic noise. "*Tsk-tsk*. Haven't you figured it out yet?"

"Huh? Figured *what* out?"

While one hand kept a firm grip on his warp projector, Smedley Faversham cast his other arm in a wide sweeping gesture which encompassed the whole desert landscape. "Look at the ground where your time machine landed: a broad impact crater, where some large object moving at high speed gouged the earth and then skidded on impact. Look at the wreckage of your time machine: fragments of metal and synthetic substances, unknown to the engineers and metallurgists of this backwater century. Pieces of circuitry, far too complex for any mere twentieth-century scientist to decipher. Don't you see what you've done?"

The stranded chrononaut made a gubbling noise.

"This is 1947, the beginning of the flying-saucer craze," said Smedley Faversham. "When the officers from Holloman Air Force Base get here in a few minutes, they'll find your damaged time machine and they'll assume that it's the wreckage of *an alien spaceship.*"

Tom Morrow gubbled again, and regubbled. "You mean that I . . ."

"Indeed you did." Smedley Faversham nodded. "This is a textdisk example of the Precipitation Paradox. By traveling into the past to witness an event in recorded history, you've precipitated it: you've *caused* the event that you came yesterwards to observe! Get it? The wreckage of the so-called Roswell spaceship was really *your time machine.*"

The shipwrecked time-traveler's face turned simultaneously red with embarrassment and purple with rage . . . which was appropriate, since red and purple make maroon, and he was *marooned* in this century. "But . . . but . . ." Tom Morrow spluttered. "All the history disks say that *the corpses of alien beings* were recovered from the Roswell saucer crash."

Once more, Smedley Faversham gestured across the broad desert. "Do you see any dead aliens? Obviously, the history books—or tapes, or disks—can be mistaken."

Tom Morrow looked ashamed and disappointed. "Ever since I was a boy, and I heard about the Roswell saucer crash, all I ever wanted was to travel back to 1947 and see it for myself." He shook his head, and choked back a sob. "And now

I find out that *it was me all along* . . ."

"Well, these things happen," said Smedley Faversham. "You're not the only time-jockey who precipitated the history he intended to witness. I once yestered all the way back to seventeenth-century France, just to meet the Man in the Iron Mask . . . and when I got there, I couldn't get my helmet off. I couldn't even raise the faceplate."

Tom Morrow stopped sniveling, and looked up. "And what happened?"

"Never mind," said Smedley Faversham. "Let's just say that French cuisine is highly overrated. Or at least it was in the Bastille. Anyway, it's high time we were getting you back to your own century."

"Shouldn't we clean up this mess first?" asked Tom Morrow, frowning at the long strew of wreckage that had once been his time machine. "It's against the time-laws to leave litter in somebody else's century."

"You forget," said Smedley Faversham. "We're *supposed to* leave this wreckage here for the Air Force officers to find. Otherwise, how would the history disks ever report that a flying saucer crashed near Roswell, New Mexico, on July 2, 1947?"

"Oh, that's right." Tom Morrow squared his shoulders. "I guess I'm ready to go back to my own century now."

Smedley Faversham pressed a button on his warp projector. The wormhole in space-time—which had been quietly minding its own business during this conversation, and sucking air molecules into its insatiable vortex—now moved steadily across the desert towards Tom Morrow. He took a deep breath, and stepped into the wormhole. Halfway through its aperture, his expression abruptly changed.

"Hey, *wait!*" he yelled in sudden terror. "*This isn't my century in here! It's* . . ."

"So long, sucker," said Smedley Faversham. There was a slurping noise, as the time-space paradox engulfed Tom Morrow. For an instant, his scream rang out across the New Mexico desert . . . then it was suddenly cut off.

Whistling merrily, Smedley Faversham redirected the trajectory of his wormhole, widening its orifice to encompass all the wreckage of the shattered time machine, and a considerable amount of sand and air as well. All of this physical matter vanished into the wormhole, bound for the very same time-space coordinates to which Smedley Faversham had sent Tom Morrow.

"It pays to be neat," said Smedley Faversham. He switched off his warp projector. Taking one last look around, to make sure that he had obliterated every last shred of evidence that any visitor had ever landed in the desert two miles west of Roswell, New Mexico, on the night of July 2, 1947, Smedley Faversham vanished.

And then he came right back again.

That is to say, he deja-vooed himself. Smedley Faversham stepped backwards in time, intersecting his own time-line at a point precisely ten seconds *before* Tom Morrow's timeship had arrived. But, on this revisit, Smedley Faversham took extreme care to approach the nexus of his arrival point from a different space-time vector, so that he would avoid coexisting with himself for more than a single quantum instant. And now the cycle repeated.

"Here comes another one," said Smedley Faversham.

A hole opened in the night sky. There was a halo discharge of Cherenkov radiation as the wormhole widened and an oncoming vessel appeared. Smedley Faversham had never seen this particular vessel before, and yet he recognized it instantly as a time machine.

This time machine was obviously a garage job: it lacked the lean, classic lines and efficient chronodynamics of a professionally-engineered timeship. The Heisenberg tracking grid looked like it was held together with duct tape. Smedley snorted in contempt. "A real do-it-yourselfer," he said disdainfully. "Must be from one of those alternate time-lines where the principles of warp field dynamics are public knowledge, so that any eager-beaver with a Lego set and a handful of tachyons can go time-jaunting. *Hmmph!*"

At that instant, the Cherenkov glow faded and the time machine emerged into conventional space-time. Unfortunately, it emerged *upside down.* It arrived in midair, some thirty meters above the New Mexico desert: ten meters higher than the space-time nexus where Tom Morrow's ship had emerged, and slightly farther to the left.

The upside-down time machine struck the ground hard, sending fragments of itself in all directions. The largest remnant was undoubtedly the pilot's cockpit. Smedley Faversham walked towards this, in a leisurely stroll. But suddenly, with a hiss of concealed hydraulics, the cockpit jettisoned an ejector seat. Aiming his flashlight straight up into the night sky, Smedley watched as the ejector seat activated a parachute, and the time machine's occupant drifted gracefully down towards a sand dune in the Roswell desert.

Emblazoned on the parachute's white fabric was a black insignia resembling the phonetic symbol known as a *schwa.* The parachutist wore a tight-fitting silver costume that looked like some adolescent's notion of a spacesuit.

Smedley Faversham reached the sand dune just as the stranded time-pilot was folding his parachute. At the sound of Smedley's approach, the skydiver whirled to confront him. The new arrival was a pimple-faced teenager, and he glared at Smedley Faversham suspiciously.

"Who are you?" the teenaged time-traveler demanded. "Let me guess: you're CIA. You're not in uniform, so you can't be Air Force. Wait; I know who you are!" The newcomer looked Smedley up and down, with an expression of utter scorn. "You're a Man in Black!"

"Who, me?" Smedley glanced modestly at the outfit he was wearing. "Actually, it's more of a mauve and fuchsia houndstooth, with tattersall highlights. Faversham's my name: Smedley Faversham. And you are. . . ?"

"Don't pretend you don't know who I am," said the juvenile time-jaunter. "You've probably got a whole X-file on me. I won't divulge my true identity. You can call me Agent Schwa."

"Well, if I must . . ." said Smedley Faversham.

"I know why you're here," said Schwa accusingly. "It's *your* fault my time machine was upside down when I outwarped. You probably sabotaged my timeship, as part of your mission!"

"Beg pardon?" Smedley Faversham stared absently. "My *mission?*"

"You were sent here to cover up the crash of the Roswell spaceship, and the alien autopsies." The teenaged Schwa whipped out his own flashlight, and sent its beam glaring into Smedley's face. "What have you done with Amelia Earhart?"

"Well, she . . ."

"Don't lie to me," said Schwa, with all the outraged moral dignity that a pimple-faced teenager in a cheap spacesuit could possibly muster. "The Roswell spaceship crash occurred on the night of July 2, 1947: *exactly ten years to the day* after the last known radio transmission was received from Amelia Earhart. Coincidence? *Hah!* I don't think so! Are you from Area 51?"

"No, I'm self-employed," said Smedley Faversham . . . even though, at this same precise moment in a completely different time-line, he had told Tom Morrow that he worked for something called the Chrono-Commission. "I'm an independent businessman."

"That's a lie," said Agent Schwa. "You're from the government. *All* government officials are liars."

Smedley Faversham had his own opinions about the government, but it struck him that this was an unfair generalization. "Wait a minute, son. *All* government officials are liars?"

"All except JFK." Agent Schwa's teenaged face took on an expression of beatific awe, amid the pimples. "John F. Kennedy knew the truth. He never lied to the American people."

"Of course not; he was too busy playing tonsil-hockey with Mafia hookers in the Lincoln bedroom," said Smedley Faversham, who had visited the time and place in question during one of his previous time-trips, and brought back evidence. "Look, junior: you're obviously the product of some highly enlightened quasi-Utopian society of the far-distant future, so I'll level with you: I'm a time-traveler too."

The teenager squinted at Smedley Faversham sidelong and crosswise. "You *are?*"

"Of course," said Smedley Faversham. "Now that time-travel is within the capability of any snot-nosed punk with . . . *ahem!* . . . I mean, now that time-travel is within the reach of every skeptical inquirer, did you expect to be the only person who would decide to find out what really happened in the desert near Roswell, New Mexico, on the night of July 2, 1947?"

"Gee, I never thought of that." Agent Schwa scratched himself, and peered at his surroundings in the twilight. "Now that you mention it, I'm surprised that you and I are the only time-travelers here. In *my* time-line, so many people are interested in the Roswell spaceship crash, you'd think they would all come yestering back here just to see it for themselves."

"Maybe they stayed home because they knew the truth," said Smedley Faversham. "In *my* time-line, it's a matter of public record that there *never was* a Roswell spaceship crash. No aliens, and therefore no alien autopsy." Smedley Faversham pointed his flashlight beam along the trail of rubble left by Agent Schwa's damaged timeship. "See what your time machine's done, kid? A mark in the ground, where something fell from the sky. Weird circuitry, unknown materials. When the Air Force officers from the 509th Bomber Group come here to investigate . . . well, you see what I'm saying? The so-called Roswell spaceship is really *the wreckage of your time machine.*"

"No! That's a lie!" protested Schwa, while Smedley Faversham calmly whipped out his pocket-sized warp generator and keyed in a series of commands. "You must be part of the cover-up! I'll bet you took . . . hey, what are you doing?"

"Oh, nothing much," said Smedley Faversham, who had quietly created a space-time aperture in midair, and was now widening it to the proportions of a doorway. "I have to return to headquarters and make my report. You're right about me, of course: I was sent here with orders to collect the bodies of the dead aliens."

"I *knew* it!" Agent Schwa's voice was triumphant. "And after you removed the wreckage of the *real* spaceship, you left a damaged weather balloon at the crash site, as part of the cover-up!" The teenager's eyes took on a predatory gleam. "Where did you hide the evidence?"

"Oh, it's in *here,*" said Smedley Faversham, gesturing towards the space-time portal that stood hovering in midair. "I keep the Roswell artifacts neatly filed, alongside the Bigfoot videos and the Elvis archives, right next to the evidence that proves who *really* shot JFK. But you're not allowed in here, of course."

"The hell I'm not!" The pimple-faced time-jaunter stepped forward, ready to challenge Smedley Faversham. "The public has a right to know! The truth is out there!"

"No, actually the truth is in *here* . . ." said Smedley Faversham, pointing to the vortex of his portable wormhole. Grinning victoriously, Agent Schwa elbowed

Smedley aside and jumped past him into the time-space orifice. Instantly, the teenager's smug grin was transmogrified into a look of sheer terror.

"*You lied to me!*" the adolescent time-pilot squealed, battering his fists against the wormhole while it contracted to enfold him. "*There's nothing in here except . . .*"

With a faintly dyspeptic belch, the space-time vortex winked out of existence. The protests of its unwilling passenger were cut off in mid-screech.

"I thought he'd never leave," said Smedley Faversham, opening the wormhole again. Cheerfully whistling a melody that hadn't been written yet—it was a hit tune from a musical that would open on Broadway in 2637 A.D., the same year that *Cats* finally closed—Smedley Faversham widened his wormhole's vortex until it engulfed the wreckage of Agent Schwa's time machine. All the pieces of the time machine, including the duct tape, were sent to the same destination in space-time to which Schwa himself had gone. This was, of course, the same space-time nexus to which Smedley Faversham had previously sent Tom Morrow, and *his* time machine, and countless *other* time-travelers, along with the wreckages of *their* time machines . . . all of whom had traveled yesterwards along their time-lines for the express purpose of finding out what *really* happened in the Roswell desert on that fateful night in 1947.

Smedley Faversham glanced at his wristwatch, and yawned. "I think I'll try for just one more, and then knock off for the day," he decided. "I'll come back for the next batch of saucer-chasers some other time . . . whoops! I mean the *same* time, of course." Smedley chuckled at his own error. Time-travel being what it is, Smedley could yestervisit July 2, 1947, any old time whenever he felt like it, from any departure point along the time-stream of his own existence.

So now, once again, Smedley Faversham deja-vooed himself. He stepped backwards in time, then returned to the same here-and-now, from yet a different direction.

"Here comes another one," said Smedley Faversham.

Once more, a hole opened in the night sky. Once more, there was a halo discharge of Cherenkov radiation as the rift in space-time widened and a visitor from elsewhen emerged.

This time, however, there was no time machine. A human figure appeared in the wormhole. The new arrival was an unspeakably beautiful woman, clad in a tight-fitting black uniform. On the left side of her formidable chest was a small silver emblem depicting a balance scale superimposed across an hourglass: the scales of Justice and the sands of Time.

"Cheese it, the Time Cops!" said Smedley Faversham. He reached into his cummerbund and whipped out a portable space-time bandwidth jammer. Quickly, he set the jamming device for maximum scatter. But the female chrono-constable whipped out a device of her own, and keyed in several commands that kept the wormhole focused tightly on its current space-time vector. Smedley watched helplessly as the policewoman modulated the wormhole's spatial coordinates so that it descended to ground level, whereupon she gracefully stepped out of the wormhole and it vanished behind her. In a desperate attempt to conceal his malfeasances, Smedley Faversham crammed his jamming device back into his aforementioned cummerbund, just as the unspeakably beautiful woman strode towards him across the New Mexico sands.

"Well, well! If it isn't Smedley Faversham, the intermillennial time-smuggler," she said. "Is that a space-time bandwidth jammer in your cummerbund, or are you happy to see me?"

"Uhhhh . . . both, actually," said Smedley Faversham, displaying an attitude of cheerful ebullience . . . with the emphasis on *bull.* "Well, well!" he smarmed with utmost unctuence. "If it isn't my arch-nemesis, Julie Anne Callender of the Paradox Patrol! How are your brother Gregorian and your uncle Nougat?"

"They're fine, thanks," said Julie Anne Callender, taking out a set of gleaming handcuffs. "My brother Greg is patrolling the Triassic beat. And my uncle—by the way: his name isn't Nougat, it's *Newgate*—just got his upgrade to the plainclothes division. He'll need different clothes for every century on his beat, in order to blend in with the natives, but Uncle Newgate always liked a challenge." Officer Callender twirled her handcuffs, and gazed longingly at Smedley Faversham's wrists. "Mind telling me what you're doing in Roswell in 1947?"

"I was wondering likewise about *you,*" Smedley replied. "Ladies first."

"Fair enough." Julie Anne Callender tucked her handcuffs into the bodice of her tight-fitting uniform. From somewhere else within, she produced a small datacard. She brought up the display text on this, and proceeded to scroll through the text on the pocket-sized card while she spoke to Smedley Faversham: "We've been getting reports of a space-time disturbance at these coordinates: two miles west of Roswell, New Mexico, on the night of July 2, 1947. For some reason, time-travelers from all across the millennia keep converging on this particular nexus . . . and then vanishing without a trace. I don't suppose you'd know anything about it, eh?"

"I'm the soul of innocence," said Smedley Faversham.

"Of course you are," said Julie Anne Callender. "I've been checking your file down at Headquarters. You've been a busy little chrononaut. You've got souvenir stands set up at all the most popular time-tourist destinations." She consulted her datacard. "It says here you've got a souvenir stand aboard the *Titanic* in 1912, another one in the Roman Senate on the Ides of March, 44 B.C., and one in Ford's Theater in 1865. You're selling binoculars to time-tourists on the grassy knoll near Dealey Plaza in 1963, and you're conducting three-day tours of the Crucifixion." As she said this, Julie Anne Callender squinted at an incoming readout on her datacard, and she whistled in surprise. "Hey! Headquarters just informed me that you've been sighted under an airtight dome on the moon in July 1969, conducting guided time-tours of the Apollo Eleven landing. It says here you're selling pieces of the lunar module as souvenirs."

"Am I?" asked Smedley Faversham in genuine surprise. "I hadn't thought of that one yet . . . but now I guess it's predetermined that I'll do it. That's one of the advantages of time-travel: I can manage all my business interests in different centuries simultaneously. Anyway, Julie my gendarme, none of my enterprises have damaged the space-time continuum . . . so you can't charge me with any chrono-crimes."

"Maybe not," Julie Anne Callender admitted. "But I've got orders to clear up the mystery of this chronogational hazard in 1947 Roswell, and I'll bet *you've* got something to do with it."

"Indeed I do." Smedley Faversham adjusted his cummerbund, and cleared his throat. "When I saw an article in the cyber-tabloids about the alleged Roswell flying-saucer crash of 1947, I realized that plenty of time-tourists would want to visit that event. Who *wouldn't* pay good money for a front-row seat at the crash landing of a genuine alien spaceship? So I yestered my way back here to scout the prospects for a guided time-tour. But when I got here, I discovered that *there never was* any spaceship crash in Roswell. No spaceship, no wreckage, no dead aliens. Not even a punctured weather balloon."

"No paranormal anomalies at all, eh?" Julie Anne Callender asked.

"I didn't say that," said Smedley Faversham. "Instead of a wrecked spaceship, I found a steady procession of time-traveling UFO enthusiasts. Every single one of them, in his or her individual time machine, came jaunting yesterwards from various millennia, and all of them converging at the same space-time coordinates: two miles west of Roswell, on the night of July 2, 1947. They all came to witness the never-happened landing of a nonexistent spaceship."

"I get it." The female Time Cop nodded. "And I can guess what happened next. You set up your bandwidth jammer so that—*if anyone tries to time-visit* this particular nexus—their timeships always materialize in midair, and then crash on arrival. *Tsk-tsk*. Shame on you."

"Guilty as charged," said Smedley Faversham. "I got the idea from a land pirate in eighteenth-century Cornwall, who showed me how his crew used false beacons to lure merchant ships onto the rocks . . ."

". . . and then rob them." The female Time Cop nodded. "But flat-out robbery isn't your style, Smedley. What did you do with all those missing time-travelers who tried to visit Roswell, New Mexico, on July 2, 1947?"

"I'll never tell," said Smedley Faversham. He sauntered away from her, humming an artless little tune: "*Dum-dee-dah, dum-dee-dee* . . ."

"Spill it, Faversham," said chrono-constable Callender, with a no-more-nice-guy tone in her contralto voice. "Do I have to handcuff you and work you over?"

"*Dum-dee-* . . . say, that might be interesting," said Smedley Faversham, changing direction in mid-saunter, so that he was within easy reach of the long arms and goddess-like thighs of the law. "You may have to get *very* rough with me."

"Yeah, I'll bet." Julie Anne Callender reached into the tight-fitting bodice of her uniform and she pulled out a tesseract-shaped object equipped with multicolored blinking lights. The lights were rigged to activate in the *past* and the *future*, but to remain switched off in the *present*. This meant that the signal device's power cells would remain charged indefinitely, since—at any given right-this-moment *now*—the signal device was always off-line.

Callender switched on her warning-buoy and carefully anchored it, so that it would remain at a fixed position in the time-stream. "There! If any more time-pilots try to chronogate through this particular vector, they'll get a warning to steer clear of Roswell in July 1947."

"That's not fair!" said Smedley Faversham. "I need a steady supply of time-travelers! I've been sending them and the wreckage of their timeships back to . . ."

"*Yes?*" asked Patrolwoman Callender. Her fingers poised expectantly over her datacard, ready to input the full text of Smedley Faversham's confession. "You were saying. . . ?"

"*Dum-dee-dah* . . ." hummed Smedley Faversham. "*Dum-dee-dee* . . ."

Callender put away her datacard. "Look, Smedley: we both know that I can go back to Headquarters and put a time-trace on you, following you from these coordinates and working yesterwards and futurewards until I find out what you're up to. So here's the deal: tell me what you did with all those Roswell time-travelers, and I won't mention any of this in my report."

"Oh, very well." Smedley Faversham cast a last longing look at the portion of Julie Anne Callender's uniform where she had stowed her handcuffs, and he confessed: "When I first found out about the Roswell spaceship crash, one of the cyber-tabloids mentioned a similar unexplained incident which took place several decades earlier." Smedley checked the readout panel in his cummerbund. "To be precise, an incident that occurred at 7:17 A.M., local time, on June 30, 1908 . . . in the wilderness known as Tunguska, Siberia."

"Hold that thought, bub, while I access the archives at Paradox Central."

Julie Anne Callender plunged a hand into the bodice of her uniform, and pulled out another datacard. She tapped several Search commands into this, then consulted the readout. "*Hmmm.* It says here that the Tunguska incident was an unexplained explosion in midair, ten kilometers above the Earth's surface, which leveled the entire Siberian forest over an area of 2,200 square kilometers. The explosive force was equal to twenty megatons of dynamite, and it registered on seismometers in London and New York." Officer Callender whistled in astonishment. "Wow! Talk about your Big Bang!"

"Precisely," said Smedley Faversham. "And the Tunguska incident has never been explained. No impact crater or debris were ever found. Of course, there are various theories about what caused the explosion: a meteorite, a comet, a black hole. The most popular theory claims that *an alien spaceship* had some sort of onboard disaster. Just before their ship exploded, the alien crew attempted a landing in one of the least inhabited regions of Earth. That would explain why the Tunguska explosion—which could have destroyed one of Earth's major cities—occurred in such an isolated area instead. Anyway, I realized that most of the time-tourists who would want to visit the Roswell spaceship crash in 1947 might be equally interested in witnessing the Tunguska incident in 1908."

"Sounds good to me," said Officer Callender. "But such a powerful explosion . . ."

"Ah, that's what gave me the idea," said Smedley Faversham. "There are obvious risks in planning a day trip to the space-time coordinates of a thermonuclear cataclysm. That's where I saw my chance to make money. Say, Julie, you've got some vacation time coming, haven't you? Here, take one of these." He handed the policewoman a colorful holo-brochure.

PLANNING A TIME-TRIP TO TUNGUSKA?

asked the boldface headline. Underneath this, the text explained:

> *Don't time-jaunt solo and risk the repercussions. Book your time-trip with Tick-Tock Time-Tours* (S. Faversham, CEO), *and you can witness the Tunguska explosion in comfort and safety from your reserved seat inside our radiation-proof stasis field. A selection of beverages and meals are available, as well as souvenir radiation tags, T-shirts, bumper stickers . . .*

And so forth. At the bottom of the sales pitch was a copyright notice, with a date that Julie Anne Callender couldn't read properly. She held the holo-brochure at several angles, and then she realized that the date on the copyright notice kept scrolling through a near-infinite series of years, so that copyright was renewed indefinitely. The name of the copyright holder, however—Faversham Enterprises—remained clear and unchanging.

Julie Anne Callender folded the holo-brochure, and tucked it into one of the less interesting regions of her uniform. "This sounds like one of your typical money-spinners, Smedley."

"Oh, it is indeed." Smedley Faversham lowered his eyes modestly, and studied his fingernails. "And very profitable, too. Thanks be to Paradox, at this very moment—while I'm standing here talking to you in New Mexico in 1947—I'm also conducting a guided tour from the interior of a stasis field in Siberia in 1908. And making *mucho* mega-moolah."

"No doubt," said chrono-constable Callender. "I guess that I can figure out the rest of your scam. If any time-jaunters try to visit 1947 Roswell, you deliberately wreck their timeships. Marooned in 1947, with no transportation back to their own era, they're at your mercy . . . so you shanghai them into signing up for time-tours of Tunguska in 1908. For a price, of course."

"Um, sort of," said Smedley Faversham. "Well, you've penetrated my fiendish strategem and pierced my time-bubble . . . so shouldn't you be heading for your next assignment in some other century? Don't you have to go rescue Ambrose Bierce, or something?"

"Not so fast, time-boy," said Julie Anne Callender. With one gloved hand, she took out her nightstick and whacked it sharply into the palm of her other hand, while she gazed at the surface of Smedley Faversham's forehead as if searching for structural flaws. "Let's have it, Faversham: what did you do with all those time-travelers you abducted from 1947 Roswell?"

"Ummm, they vanished into the corridors of time?"

"Try again."

"Oh, very well." Smedley Faversham sighed wearily. "The first time I went yesterwards to the space-time coordinates of the Tunguska explosion in 1908—I was enfolded in a stasis field, of course—I discovered that *not a damned thing happened.* There was no comet, no asteroid, no black hole, and there sure as hell wasn't any alien spaceship. The explosion *never took place.* Well, I couldn't sell time-tickets to an event that never happened. And I couldn't sell tickets to the Roswell spaceship crash either, since that *also* never happened. But then I had an idea . . ."

Julie Anne Callender groaned. "I'm beginning to see where this is heading."

"Yes, indeed!" Smedley rubbed his hands gleefully. "Whenever I have an idle moment between all my time-tour activities, I return to Roswell on the night of the alleged UFO crash, and I scuttle yet another time machine in the endless series of time-travelers who come back to 1947 looking for a spaceship that never existed."

"How many time-travelers have you waylaid this way?" Officer Callender asked.

"I stopped counting at five thousand . . . and there's plenty more where *they* came from," said Smedley Faversham smugly. "The space-time continuum seems to contain an infinite number of idiots who actually believe that a flying saucer landed in Roswell in 1947. Anyway, each time I shipwreck one of these jerks, I send the time-traveler—*and* the wreckage of his time machine—back to a space-time nexus located in . . ."

"Let me guess," said the female Time Cop. "You send them to a point in midair, ten kilometers directly above the Tunguska wilderness, at 7:17 A.M., June 30, 1908."

Smedley Faversham nodded.

"But surely," said Julie Anne Callender, "since each time-traveler maintains his or her own unique vector through space-time . . ."

Smedley Faversham smiled fiendishly, and shook his head *no.*

Julie Anne Callender saw this, and shuddered. "Wait a minute. The combined physical mass of more than five thousand time-travelers, plus the physical mass of more than five thousand time machines? But if you sent all those separate quantities of matter to converge at *the same arrival point in space-time,* it would make . . ."

"Yes, it does," said Smedley Faversham. "It definitely does. A very, *very* large explosion. Awe-inspiring. The time-tourists who witness the Tunguska explosion from the safety of my stasis field always get their money's worth. Some are repeat customers. When they come back the second time, they get to watch themselves watching the Tunguska explosion the first time." Smedley Faversham wiped his forehead, and loosened his cummerbund. "Now I guess you're going to arrest me for murdering five thousand time-travelers."

"How can I?" asked chrono-constable Callender. "Chronocide doesn't violate the time-laws. All time-travelers proceed at their own risk. And thanks to Bester's Law, any murders you commit in the past or the future can only alter your own time-line, never anybody else's. In fact, I distinctly recall that you and I have killed each other several times during some of our previous temporal *tête-a-têtes.* Nothing personal, of course."

"Of course not," said Smedley Faversham. "Paradoxicide isn't a time-crime."

"And besides," said the Paradox Patrolwoman, "all the time-travelers you killed were UFO nuts. With infinite vistas of space-time unfolding before them, they had nothing better to do than go chasing dead aliens and nonexistent flying saucers in Roswell in 1947. If there's one thing the space-time continuum doesn't need, it's a bunch of flying-saucer nuts. You killed them? Good riddance."

"Thank you, m'dear," said Smedley Faversham, while his cummerbund swelled with pride . . . or perhaps the swelling in his cummerbund indicated that the miniature nuclear reactor inside his space-time bandwidth jammer was attaining critical mass.

"If it were up to me, Smedley, you'd get a medal for this. But it's not up to me, so . . ." With a deft movement, Julie Anne Callender whipped out her handcuffs, and clamped them onto Smedley Faversham's wrists. "Come on, sunshine. I'm taking you in."

"But I haven't committed any time-crimes!"

"Maybe, maybe not," said Officer Callender of the Paradox Patrol. "But there's no way the precinct captain will believe me if I put this in my report. So I'm taking you back to Paradox Central, and you can explain your chrono-caper to my superiors."

"Your superiors!" sneered Smedley Faversham. "A bunch of fat desk-jockey Time Cops, sitting around eating doughnuts . . ."

"Please," said Patrolwoman Callender, with genuinely wounded dignity. "At least get the topology right. I'll admit that we Time Cops eat closed-loop pastries, but they're not shaped like toroids. They're more like Möbius strips. And we drink coffee out of Klein bottles. Anyway, Faversham, you're under arrest. There must be *some* time-crime I can charge you with, even if it's just lewd tesseracts or some other misdemeanor."

"You'll never take me alive, chronocopper!" Freeing himself from the handcuffs with laughable ease, Smedley Faversham whipped out a proton blaster and fired a high-intensity energy beam squarely into Julie Anne Callender's delectable midriff. She died instantly. This was no great tragedy, since the principles of Paradox guaranteed a near-certainty that—at some future point in space-time—Julie Anne Callender, very much alive, would cross paths with Smedley Faversham somewhen else in the time-stream. And the next time their paths crossed, it might be Smedley who died. Or both. Or neither. Yadda yadda yadda.

Whistling merrily, Smedley Faversham took out his pocket-sized warp projector, and keyed in a string of commands. Obediently, the wormhole appeared. Making certain that the other end of the wormhole emerged at its usual nexus in midair above Tunguska in 1908—he had the precise space-time coordinates on speed-dial—Smedley picked up Julie Anne Callender's lifeless body and flung it into the vortex of the space-time maelstrom. "Sorry about this," said Smedley Faversham. "But every kilogram of physical mass that I can add to the Tunguska incident in 1908 makes the explosion that much bigger . . . and more exciting for my customers. Nothing personal."

"Oh, I agree," said a voice behind Smedley Faversham. He turned around, at the precise instant that a fist slammed into his jaw and sent him staggering. "Nothing personal at all."

And then, as Smedley Faversham was bodily lifted towards the wormhole—where his molecules would converge with the molecules of several thousand previous time-travelers, and make one very large explosion—the very last thing he saw was the face of his attacker.

Himself.

"Nothing personal," said the newly-arrived Smedley Faversham to the previous Smedley Faversham, as he brought the other version of himself to the wormhole's event horizon. "Thanks to Officer Callender's warning-buoy, my unlimited supply of time-victims arriving in 1947 Roswell has finally run out. Or maybe the people in the future have finally realized that there never was a spaceship crash at Roswell. Anyway, I got tired of waiting for another victim, so I doubled back across my own timestream and decided to help myself . . . to *you.* You've been putting on a bit of weight, Smedley, haven't you? As you say, every kilogram that I can send back in time to Tunguska helps the cause." He flung his previous self into the wormhole. "Happy landings in 1908 . . . and nothing personal."

"Oh, I agree," said a voice behind this latest Smedley Faversham. He turned around, just in time to get beaned on the noggin with a crowbar brandished by yet another Smedley Faversham. "Ta-ta, old boy," said this latest edition of Smedley Faversham, as he picked up his paradox predecessor and shoveled him into the wormhole. "With my time-travel enterprises making so much money, you can't expect me to split the profits with a partner . . . even if that partner is *myself.* Nothing personal."

"Oh, I agree," said a voice behind this latest Smedley Faversham. He turned, just in time to get conked in the bazoo with a sashweight. Just before he was flung into the wormhole's void, *this* Smedley Faversham had the satisfaction of seeing yet another Smedley Faversham materializing behind the one who had conked him. And *this* Smedley Faversham was wielding a Webley-Vickers cavalry pistol . . .

The one behind *him* had a machine gun. And the one behind *him* . . . well, suffice it to say that the procession of Smedley Favershams expanded exponentially, as he stepped through an infinitely varying series of dimensional vectors and returned repeatedly to confront all of his previous selves in the same space-time nexus. Each new Smedley Faversham clutched a weapon more fearsome than those of his predecessors, and each new Smedley Faversham was hellbent to obliterate all the other Smedley Favershams. In an infinite series.

Let us leave them there, Gentle Reader, and tiptoe safely away.■

(Editor's Note: This story is a sequel to "Timelines" (June 1999).)

The astonishment of life is the absence of any appearances of reconciliation between the theory and the practice of life.

— Ralph Waldo Emerson

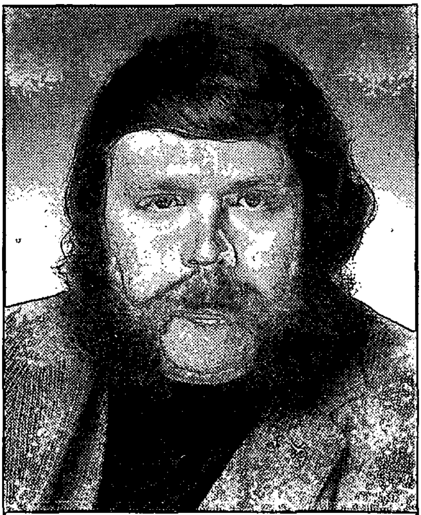
BIOLOG Jay Kay Klein

F. Gwynplaine MacIntyre's life echoes the fictional Oliver Twist and the legendary Dick Whittington. Bought, stolen, or abandoned, he was raised in the outback of Australia by Scottish immigrants who worked as migrant laborers in cattle and sheep stations. Neither nurturing nor kindly, they sometimes exhibited him at country fairs as the Frog Boy. He had webbed fingers and toes along with other genetic oddities, and bowed legs from severe rickets. He still cheerfully answers to "Froggy," though officially he has chosen "Feargus" as a first name. Eventual enquiries established his birthplace as Scotland, and he selected MacIntyre as a surname. He added Gwynplaine after the swashbuckling hero of a Victor Hugo novel.

This couple thought it cruelly funny to tell the boy he was an ET from some star. He seriously tried to work out the most likely star, and read everything he could about astronomy and space travel.

Finally escaping, he lived with a series of protectors. Some were urbanized aborigines who thought the frog boy with flaming red hair was a supernatural being. Knowledge of aboriginal culture was background for his story in the March 1980 *Isaac Asimov's Science Fiction Magazine.* Blackfellow perceptions of time and space and the blurred distinction between reality and imagination had a profound influence on the young boy.

Froggy worked at whatever he could turn his awkward hands to, even to being a "tar boy" in a shearing shed. When he heard "Tar up!" he snatched up the tar pot kept bubbling over a fire and cauterized a struggling, bleeding sheep or a cursing, bleeding man. Time was money to pieceworkers who wielded razor-sharp shears.


F. Gwynplaine MacIntyre
photo by Vanessa Jones-Rutledge

In early teens, he was sheltered by a kindly woman who assured him he was fully human and arranged surgical corrections. Imperfectly done by unskilled practitioners, this left scars on his hands and elsewhere, with legs twice broken, reset, and permanently weakened. Often thought an eccentric dresser with leather gloves and riding boots, Froggy is merely dressing sensibly to cover scars and using footwear with inserted steel rods to support weak ankles. A cane is kept handy in case his legs should give way. His "guardian angel" spirited him away from busybody authorities who wanted to institutionalize him. She enabled him to attend school for the first time. Disguised for some months as a girl, he learned about the nonsense girls have to put up with. This was to prove valuable in rendering sympathetic depiction of female characters.

Like Dick Whittington, he decided to seek out the center of Empire to make his fortune. As they had for centuries, the bells of London town were sounding out "Dick/Whitt/ing/ton." Sauntering about to see the sights and whistling cheerfully, Froggy was hailed by a self-important elderly gent who stuck his head out a Rolls Royce window and said, "You there, boy! Stop that infernal noise and get out of the way!" Just arrived in London, and already Froggy had come to the attention of Winston Churchill.

Versed in assorted dodges and strategems for eking out a living, Froggy, like many a writer, had an assortment of brief jobs. Most were unmemorable but he did a one-night-stand as a human cannonball in Chipperfield's Circus. "Once was enough!" he reports. By now steeped in innumerable works of literature, he tried writing adventure stories and SF novels, all mercifully published under house pseudonyms and untraceable back to him. He also worked on the tech crews of various TV programs, including *The Champions* and *The Prisoner.*

Interest in books led Froggy to visit libraries in Oxford. At Christ Church College he met *Analog* author James Blish. Froggy loved language and wordplay and liked to discuss ideas, moral concepts, and scientific innovations. Jim told him he had the background and ability to become a professional author. In 1979 he began selling to *Isaac Asimov's Science Fiction Magazine* and then to *Analog,* along with other magazines. He did ghost-written novels and published others under house names. Dell Trade Paperbacks published the first novel under his own name in 1994, *The Woman Between the Worlds.* This was a SF horror novel set in Victorian London. He started collaboration with Avram Davidson on a SF novel, which he is now finishing after Avram's death.

Resident in New York City half the year, he rides horseback at least once a week. The rest of the year, he spends in Gwynedd, North Wales, where he rides as often as time permits. An artful dodger at all genres, he writes whatever he can find a market for, including ghostwritten novels for persons who wish to be known as authors. A specialty of his is crossword and other puzzles. SF, fantasy, horror, and detective stories flow with equal ease from his pen. All are painstakingly researched to provide authentic time, place, and details of plot such as vocational or scientific accuracy.

With thousands of books read during his estimated half-century of life, it's no wonder he comes across as erudite and learned in literature, history, and just about any other subject. Among *Analog* authors, there are scions of millionaire families, those with multiple advanced degrees, high school dropouts, and workers in every field from handyman to rocket scientist. All are extremely bright and knowledgeable in areas beyond any possible combination of formal education. This is also very much like the readers of *Analog.*

If Froggy had stayed in London, he might someday be Lord Mayor. In America he has become a regular *Analog* author. With his astoundingly picaresque background and decades of writing time ahead, sets of bells may yet sound out "Frogg/y/Mac/Intyre."■

THE FIRST MARTIANS

The first Martians may already be alive, here on Earth. Dan Goldin of NASA says he hopes to begin serious work on a human expedition to Mars immediately after completing the International Space Station. If so, the people who will establish a permanent base for science and development on the Red Planet could be teenagers today. Somewhat generously, therefore, we can define a Martian as a young person who wants to go to Mars. This article identifies the general qualities of these future Martians, based on data from an innovative web-based survey carried out late in 1998 by the National Geographic Society, with responses from 3,185 youngsters aged 13–15. Before we get to that cutting-edge research, we need to go back in time a dozen years to the modest study that suggested it was worth looking for Martians.

The 1986 Pilot Study

On January 28, 1986, I was sitting in the pressroom at Jet Propulsion Laboratory, watching the latest pictures beamed down by *Voyager 2* as it passed Uranus, when the TV monitors switched over to NASA's direct feed from Cape Canaveral. In a few moments, we science journalists were watching the ill-fated launch of the *Challenger* and its explosion. Each of us had his or her own reaction. The *Sky and Telescope* reporter who had the desk across from mine stared grimly into space for a long minute, then picked up the telephone and changed his travel reservations. I began outlining a questionnaire that might help us understand what ideas would convince the public to support increased investment in spaceflight.

Later that spring, I administered one of a series of questionnaires to undergraduates at Harvard University, and the survey included the following item: "If you were asked to go along on the first rocket trip to the planet Mars, would you want to go or not?" The data analyzed here are from 512 students, 256 males and 256 females. The same database is included in my software and textbook package, *Social Research Methods and Statistics,* so anyone who wishes may replicate these results or try other analyses. Altogether, 55.9 percent said YES, 38.7 percent said NO, and 5.3 percent said maybe.

What does this mean? Certainly, we were not asking the students to sign a binding contract, and most of them probably knew that there were no serious plans for a Mars expedition at that time. Thus, this item measures a very general attitude about a flight to Mars rather than a firm intention to participate. But the item is not entirely abstract, and it asks the respondent in effect to say how the idea of Mars flight fits with him or her personally. Data from other items in this survey contributed significantly to my book, *Goals in Space,* and it is quite clear that most of the respondents possessed some real knowledge and many complex attitudes about spaceflight. As Harvard students, imagining themselves to be the elite of their generation, they may believe that they are capable of accomplishing almost anything, including conquest of the Red Planet.

The male students are more likely than the females to say they might go to Mars, 66 percent versus 46 percent. In part, this reflects the fact that men express more enthusiasm for having a Mars expedition in the first place. Another item in the Harvard survey asked, "There has been much discussion about attempting to land people on the planet Mars. How would you feel about such an attempt—would you favor or oppose the United States setting aside money for such a project?" About 54 percent of males and only 43 percent of females were in favor. Interestingly, both sexes seem more willing to consider going to Mars than to have the government appropriate money for the project.

Slightly deeper insight can be achieved by looking at the connections between preferences for various college subjects and being willing to go to Mars. Fully 73 percent of those who loved "astronomy" (rating it "6" or "7" on a 7-point preference scale) wanted to go, compared with just 46 percent of those who hated it (rating it "1" or "2"). Four other fields had positive correlations: geology, physics, engineering, and—surprisingly—anthropology. On the other hand, three fields were negatively related: art, sociology, and foreign languages. For example, 72 percent of the people who hate foreign languages want to go to Mars, compared with 49 percent of those who love them. Presumably they don't anticipate learning the Martian language ("kaor" means "hello," according to Edgar Rice Burroughs). Assuming that Mars is uninhabited, the positive correlations are all with sciences that actually would gain from an expedition to Mars, with the interesting exception of anthropology. It might be said that anthropologists wish to escape their own society, whereas sociologists are mired in it, and leaving the Earth is difficult for those who are stuck in the mud.

Eight years before the *Challenger* disaster, I had administered questionnaires at the world science fiction convention in Phoenix, Arizona, for my book, *Dimensions of Science Fiction.* It made sense to include some of the questions in the Harvard survey to see if the distinctions that are important to SF fans are also meaningful to college students. The traditional "hard-science" brand of SF is most relevant to a Mars voyage. Fully 74 percent of students who love "fiction based on the physical sciences" would go to Mars, compared with 39 percent of those who hate it. This difference of 35 percentage points is the largest positive correlation. Other strong connections are with "science fiction," "stories about scientific progress," and "stories about new technology." The fantasy wing of science fiction also favors going to Mars, and there are moderate correlations with "fantasy stories involving swords and sorcery," "stories about magic," and "myths and legends." The social science and experimental literature wing of science fiction—what used to be called "New Wave"—is weakly connected, at best. Students who love "fiction based on the social sciences" are somewhat more likely candidates to become Martians than those who hate this literature, 60 percent versus 47. For "avant-garde fiction that experiments with new styles" the figures are 55 percent versus 44 percent. Liking four kinds of literature is strongly associated with *not* wanting to go to Mars: "fiction that deeply probes personal relationships and feelings," "essays critical of American society," "fiction that is critical of our society," and "Feminist literature."

Whatever its intellectual meanings, an expedition to Mars would involve tremendous physical risks. The second-strongest predictor of being willing to go was preference for "taking physical risks." Of those who love taking physical risks, 68 percent would jump on board the spaceship, compared with 34 percent of those who hate such risks. Enjoying "driving fast in a car" is also positively correlated, whereas "complete personal security" is negatively connected. There is no connection either way with "taking risks in your relationships with people."

The modest results of this pilot study were quite reasonable, providing confidence that respondents really do communicate something meaningful when they say they are willing or unwilling to go to Mars. Apparently, young people who would consider joining the first Mars expedition enjoy astronomy and other sciences they might get to practice on the Red Planet. They like science fiction, especially the traditional hard-science style. And they seem to thrive on physical risks.

But there are two problems with these findings. First of all, they are pretty obvious. Social scientists frequently experience a "Catch 22" when they share their findings. People who believe the findings will say they are so obvious that there was no need to do the research. People who disagree, often on political grounds, accuse the social scientists of incompetence or data fudging. It's a no-win situation. This pilot study at least showed that a simple question about willingness to go to Mars could yield reasonable correlations with other questionnaire items. Maybe a more ambitious study could turn up results that were more interesting.

The second problem is that we cannot be sure how much the results merely reflect the fact that enthusiasm for going to Mars is more common among males than among females. Possibly variables like "driving fast in a car" merely distinguish boys from girls. Think of it this way: Men quite incidentally want to go to Mars. (Maybe the women want to go to Venus, for example.) Men, on average, are more likely to seek physical risks. When the social scientist runs the correlations, it looks like future Martians are risk-takers. In a sense they are, but only because they are disproportionately male. This is the methodological problem of *spuriousness*—the distorting effect of an unmeasured third variable (sex) on the correlation between two other variables (risk-seeking and being Martian).

A study of future Martians could turn up interesting results if it had a sufficient number of respondents to control statistically for the sex factor, and if it had a range of fresh variables that correlate with being Martian. Unfortunately, large-scale surveys are extremely expensive, especially if carried out in the traditional manner. For example, the periodic General Social Survey costs a million dollars to collect data from 1,500 American adults, interviewed face-to-face in their homes. Thus, for a dozen years I had no practical way to follow up on the tantalizing findings about young Martians, until the opportunity came along to participate in the National Geographic Society's web-based survey.

Survey 2000

"Survey 2000" was a web-based questionnaire focusing on migration and regional culture, sponsored by the National Geographic Society and organized by sociologist James Witte. From late September through early November 1998, more than 50,000 adults and 15,000 children responded to this half-hour online survey. Although the "National" in "National Geographic Society" refers to the United States, this was a truly worldwide study. Four nations contributed more than 1,000 adult respondents each: Australia, Canada, the United Kingdom, and the United States. Thirty-one others contributed more than 100 each: Argentina, Belgium, Brazil, China, Chile, Colombia, Denmark, Finland, France, Germany, Greece, Hungary, India, Ireland, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Philippines, Portugal, Singa-

Table 1

	Children	Boys	Girls
Strongly Agree	32.5%	39.9%	26.0%
Agree	28.9%	29.0%	29.0%
Disagree	23.6%	18.3%	28.3%
Strongly Disagree	15.0%	12.7%	16.6%
Total	100.0%	100.0%	100.0%
Respondents	3185	1461	1671

"If I were asked to go along on the first rocket trip to Mars, I would go."

pore, South Africa, Spain, Sweden, Switzerland, Turkey, and Venezuela.

The project was remarkable not only for being done cost-effectively over the World Wide Web, but for being one of the most technically complex questionnaire studies ever carried out by any means, exploiting many of the exciting new capabilities of computer-based electronic communications. Early questions tracked the US and Canadian adult respondents' residential moves, and the computer selected later items on the basis of the individual's history of geographic mobility. Questions about preferences in food and literature were automatically tailored to the regions of birth and current residence, and one battery of music preference items actually let the respondent hear samples of the music. Other questions concerned the respondent's Internet use versus involvement in the local community. I myself added only one item to the adult survey, asking people to write in their thoughts about what the world will be like a century from now. The roughly twenty megabytes of text I received will take months to analyze.

My main interest was the youth survey, especially the version administered to children aged thirteen to fifteen. Others had already adapted the section of the adult survey concerning preferences in music and had developed a long section asking about the child's favorite activities and interests. In addition to consulting on the overall content of the youth survey, I added items about science and technology. Each was a statement, such as "There should be a law against cloning human beings," and the respondent was supposed to respond either "strongly agree," "agree," "disagree," or "strongly disagree." One was a variant of the key item from the pilot study: "If I were asked to go along on the first rocket trip to Mars, I would go."

Table 1 shows how 3,185 children responded. About 33 percent of all children express a strong interest in being a part of the first Mars flight. Again, we should not conclude that a third of them are really ready to step aboard a spaceship to Mars, with or without their parents' permission. Rather, this is a measure of a generally positive orientation toward the idea. Actual future Martians will be a tiny minority, of course, but they should be found among those who "strongly agree" that they would go on the first rocket to Mars. The table confirms that there is a significant difference between the sexes, about 40 percent of boys wanting to go, compared with only 26 percent of girls. Given the large numbers of both boys and girls who gave each possible response, we are in a good position to learn more about the gender differences in the following analysis.

Interests and Preferences of Martians

The youth version of Survey 2000 contained 53 questions about the child's favorite activities or interests, from acting in dramas to watching TV. Really this set of items was just a list with an HTML

Table 2

	Percent Who Would Go to Mars for those Saying Activity Is:		Percentage Point Difference
	A Favorite	Not a Favorite	
Astronomy	47.1%	27.0%	20.1
Archaeology	42.6%	30.2%	12.4
Science	39.6%	28.0%	11.6
Rock Climbing	41.0%	29.5%	11.5
Martial Arts	42.3%	30.9%	11.4
Scouts or guides	41.9%	31.4%	10.5
History	39.3%	29.2%	10.1
Sailing	39.2%	31.2%	8.0
Geography	38.3%	30.3%	8.0
Mathematics	38.0%	30.1%	7.9
Computers	35.2%	27.9%	7.3
Skateboarding	38.7%	31.2%	7.5
U.S. Football	37.5%	30.1%	7.4
Video Games	35.3%	29.2%	6.1
Camping	35.8%	29.8%	6.0
Skiing	36.5%	30.8%	5.7
Hiking	36.1%	30.8%	5.3
Fishing	36.0%	30.7%	5.3
Soccer Football	34.9%	30.8%	4.1

Favorite Activities or Interests and Percent Who Want to Go to Mars

checkbox next to each, so the respondent could use the computer's mouse to check off his or her favorites. Of these 53, there were 19 that showed some statistical connection with wanting to go to Mars, and they are listed in Table 2. Of those respondents who clicked the box next to "Astronomy," indicating it was one of their favorites, 47.1 percent said they wanted to go to Mars, compared with 27.0 percent of those who did not click the box. This is a difference of 20.1 percentage points, and I have arranged the 19 items in Table 2 in descending order of this difference.

The inclusion of some of the activities and interests listed in Table 2 is a mystery, but several make perfect sense. Certainly going to Mars would be an adventure in practical astronomy, contributing to science in general, but it would take unusual optimism to believe one would really do archaeology there. Several of the activities would be required during the mission, including rock climbing, hiking, and exotic versions of camping and being a boy scout or girl scout. The organized sports listed in Table 2 have nothing to do with Mars, but the pilot study implies these items may primarily reflect willingness to take physical risks which one would surely do on the first rocket trip to Mars. On the other hand, perhaps many items merely distinguish the boys (among whom there are many potential Martians) from the girls (among whom there are fewer).

Consider video games. For all the children, knowing whether a child likes to play video games improves your ability to predict whether he or she is a Martian. A higher proportion of video-game players are Martians than of non-players. But this is entirely a reflection of the fact that boys tend to like video games. When I analyzed the boys and girls separately, there was no connection whatsoever for video game players of either sex to want to go to Mars more than non-players.

The situation is quite different for skateboarding. Among boys, preference for skateboarding has absolutely no connection with wanting to go to Mars. But among girls, there is a big connection. The definitive sociological study of skateboarding has yet to be done, and

I'm sure it has profound significance for many young people. My own (Martian) daughters sometime enjoy watching out the window, sharing derisive comments about the boys skateboarding in the street near our house, as the boys spectacularly fail to make the jumps and spins they attempt. Conceivably, skateboarding is a better measure of willingness to take physical risks for girls, few of whom skateboard, than among boys, where many do.

This is not the place to go into a deep technical analysis of the statistics, but it is worth taking a quick look. One of the tools social scientists employ to examine relationships between variables is a measure called *gamma,* which ranges from -1.0 (a perfect negative correlation), through 0.0 (no correlation) to +1.0 (a perfect positive correlation). For example, the gamma between liking astronomy and wanting to go to Mars is +0.35, a very solid positive correlation. If we separate the two sexes, gamma drops for boys to +0.28 and rises for girls to +0.39. For all students, there is a gamma of +0.20 between liking martial arts and wanting to go to Mars, but the correlation is only +0.12 for boys and fully +0.23 for girls. The overall skateboarding correlation is +0.14, but just +0.01 for boys and fully +0.22 for girls. These are actually very important findings, because they show that some factors which distinguish Martians work more powerfully for girls than for boys.

For females, it could be said that these are the best of times and the worst of times. Choices for women in contemporary American society may paradoxically be both more numerous and more difficult than those for men. Superficially, we see that women have greater freedom to wear different kinds of clothing. Nobody thinks it strange when a woman wears pants, but a man who wears skirts had better be Scottish or he is in for a load of trouble. Many women, but few men, can choose between having a career and keeping house. However, at the job women still face discrimination, and housewives face a substantial risk of being put out of business by divorce. Those brave married women who decide to have both a career and children may have to work harder than their husbands.

Three of the more violent male sports—skateboarding, U.S. football, and soccer football—give extremely revealing results. For children in general, preferences for these three sports are significantly correlated with interest in going to Mars. Among girls, there are somewhat higher correlations. But among boys, the correlations are dead zero—no relationship at all. Nothing logically connects these sports with being Martian; they are merely good measures of masculinity. From this we might conclude that girls who want to go to Mars are "tomboys," young females with boyish habits. But that would be inaccurate. Rather, some girls may have a wide range of interests, combining traditionally feminine interests with those that are traditionally masculine. Among girls, being Martian is associated with a degree of liberation from traditional gender stereotypes. We can extrapolate that the future women of Mars will be highly cosmopolitan, possibly more so than their men.

Another section of the survey asked the early-teen children about their social worlds: "Among the friends you hang out with, how important is it to . . . have a steady boyfriend or girlfriend? . . . participate in religious activities?" Respondents were asked to rate ten different values or activities in terms of how important they were. Just two of them correlated with being Martian: "finish high school," and "do community work or volunteer." Among both boys and girls, children whose peers valued completing high school and volunteering for community work were more likely to say they were ready to go to Mars. I interpret this to mean that young teenagers who value accomplishment and who are willing to volunteer for their communities, see the first Mars voyage in the same terms.

Science and Technology

Traditionally, science and engineering have been masculine fields, although females have begun to make headway recently. A comprehensive source of information about women's involvement in science is a book-sized report, *Women, Minorities, and Persons With Disabilities in Science and Engineering,* issued every two years by the National Science Foundation. The latest edition says that in 1966 women received only 8.0 percent of all American doctoral degrees in science and engineering, but their proportion had risen to 31.2 percent in 1995. Professional women scientists tend to be concentrated in such fields as biology and the social sciences, and they are especially rare in fields more closely related to a Mars expedition. For example, in 1995 women earned only 11.6 percent of American doctorates in engineering, 18.6 percent of doctorates in computer science, and 22.9 percent in physical sciences—compared with 38.1 percent in biological sciences and 63.5 percent in psychology. At earlier points in their educations, males and females are more similar. In 1994, for example, 9.1 percent of girls graduating high school had taken calculus, only slightly lower than the 9.4 percent of boys.

Among thirteen- to fifteen-year-old respondents to Survey 2000, boys do show somewhat more support for science than do girls. The Mars trip item was one of twelve that presented kids with a statement and asked how much they agreed or disagreed with it. The first said, "Science will do more good than harm in the next century." Among boys, 35.5 percent strongly agreed with this statement, compared with 21.8 percent of girls. Two items focused on general support for the space program. More boys, 24.2 percent compared with 11.8 percent, strongly agreed that "Funding for the space program should be increased." Almost exactly equal percentages, 12.8 percent of boys and 13.0 percent of girls, strongly agreed that "Space exploration should be delayed until we have solved more of our problems here on earth." But a big gender difference shows up when we look at disagreement. Fully 27.0 percent of boys strongly disagreed with the idea that space exploration should be delayed, compared with only 14.3 percent of girls. On many of these items, boys show more of a tendency to *strongly* agree or *strongly* disagree, whereas girls merely agree or disagree. But looking past this tendency of boys to give more extreme answers, we find that boys also tend to agree with pro-science statements, and to disagree with anti-science statements.

In Table 3 we see that Martians tend to be found not only among those who want funding for the space program to be increased, but also among those who support research on human cloning, who don't worry much about environmental problems, who are generally optimistic about the future, and who think development of nuclear power should continue. In contrast, Martians are harder to find among those who believe there should be a law against human cloning and who want space exploration delayed until terrestrial problems have been solved. Thus, science issues not directly related to Mars, notably attitudes toward human cloning, predict where we will find Martians.

Interestingly, I did not find the same pattern within the genders for science attitudes as I did for interests and activities. The correlations between wanting to go to Mars and each of the items in Table 3 are almost identical among boys and girls. Even though interest in science is greater among boys than among girls, it is not a measure of masculine culture that distinguishes cosmopolitan girls from non-cosmopolitan girls. This

Table 3

Do you agree or disagree?	Strongly Agree	Strongly Disagree	Percent Point Difference
Funding for the space program should be increased	62.4%	24.9%	37.5
Research on human cloning should be encouraged, because it will have great benefits for science and medicine.	57.4%	25.9%	31.5
We should not worry much about environmental problems, because modern science will solve them with little change to our way of life.	56.5%	33.6%	22.9
All in all, the world's population will be better off in the next 100 years.	54.4%	31.6%	22.8
Development of nuclear power should continue, because the benefits strongly outweigh the harmful results.	55.5%	33.4%	22.1
Science will do more good than harm in the next century.	49.7%	40.6%	9.1
We should accept cuts in our standard of living in order to protect the environment.	42.6%	38.5%	4.1
All nuclear power plants should be shut down or converted to safer fuels.	36.9%	40.3%	-3.4
Intelligent life probably does not exist on any planet but our own.	38.2%	44.6%	-6.4
There should be a law against cloning human beings.	32.2%	45.9%	-13.7
Space exploration should be delayed until we have solved more of our problems here on Earth.	32.4%	54.4%	-22.0

Science Attitudes and Percent Who Want to Go to Mars

could just mean that some of the apparently interesting findings reported above are just statistical flukes that have no real meaning. However it also could be that something very meaningful is going on here. Perhaps girls can remain "feminine" while becoming scientific. To put this another way, women may enter scientific fields and achieve within them without having to possess unusual personalities or radical values.

The next thing on my own research agenda is to examine these science attitude variables more closely, and results cannot be reported here. But I should note one of the great advantages of a large, geographically dispersed questionnaire dataset like Survey 2000. I can readily add many variables from other sources to it. For example, I can add statistics from the U.S. Census on what percentage of professional scientists are female in the state each American respondent lives in. This is a measure of how many role models a girl might have to become a scientist, and of how conducive the local culture is to female achievement in science. But while I am planning my next analysis, we need to bring the present article to conclusion.

Conclusion

We said at the beginning that our definition of "Martian" was extremely generous, merely saying, "If I were asked to go along on the first rocket trip to Mars, I would go." Now, at the end, we can seriously ask how many real Martians we have. We don't need many for the first rocket trip, maybe just half a dozen. Will they all be boys, or do girls now qualify for the Space Academy?

I developed some demanding criteria for inclusion in the ship's crew, then had my computer count how many boys and girls met these stringent requirements. Of course the person has to volunteer for the trip, so right away that reduces our pool of candidates to 583 boys and 435 girls who strongly agree they would go.

Then, it seemed to me, we could whittle the group down further by using four of the favorite interests and activities. On the intellectual side, I selected astronomy and science (in general), and on the physical activity side, rock climbing and boy/girl scouts. These four were highly ranked in table 2, and strike me as good qualifications for the job. Now we have just 51 boys and 31 girls who love all four of these and also want to go to Mars.

Of course, somebody has to pay for the expedition, and the astronauts may have to sell the public on making the investment. At the very least, that implies that the crew members need to agree strongly that "Funding for the space program should be increased." Add that criterion, and we have only 15 real Martians, 4 girls and 11 boys.

Eight seems like a reasonable size for the crew of an interplanetary spaceship, and an equal balance between the sexes ought to reduce tensions. So, all four girls should be allowed to go. Rather than impose even more stringent formal criteria to weed out 7 boys, I suggest that each girl be allowed to select a boy for the mission, based on her observation of his character during the difficult weeks of training. There's a plot for a juvenile science fiction novel! Proposed title: *The First Martians.* ■

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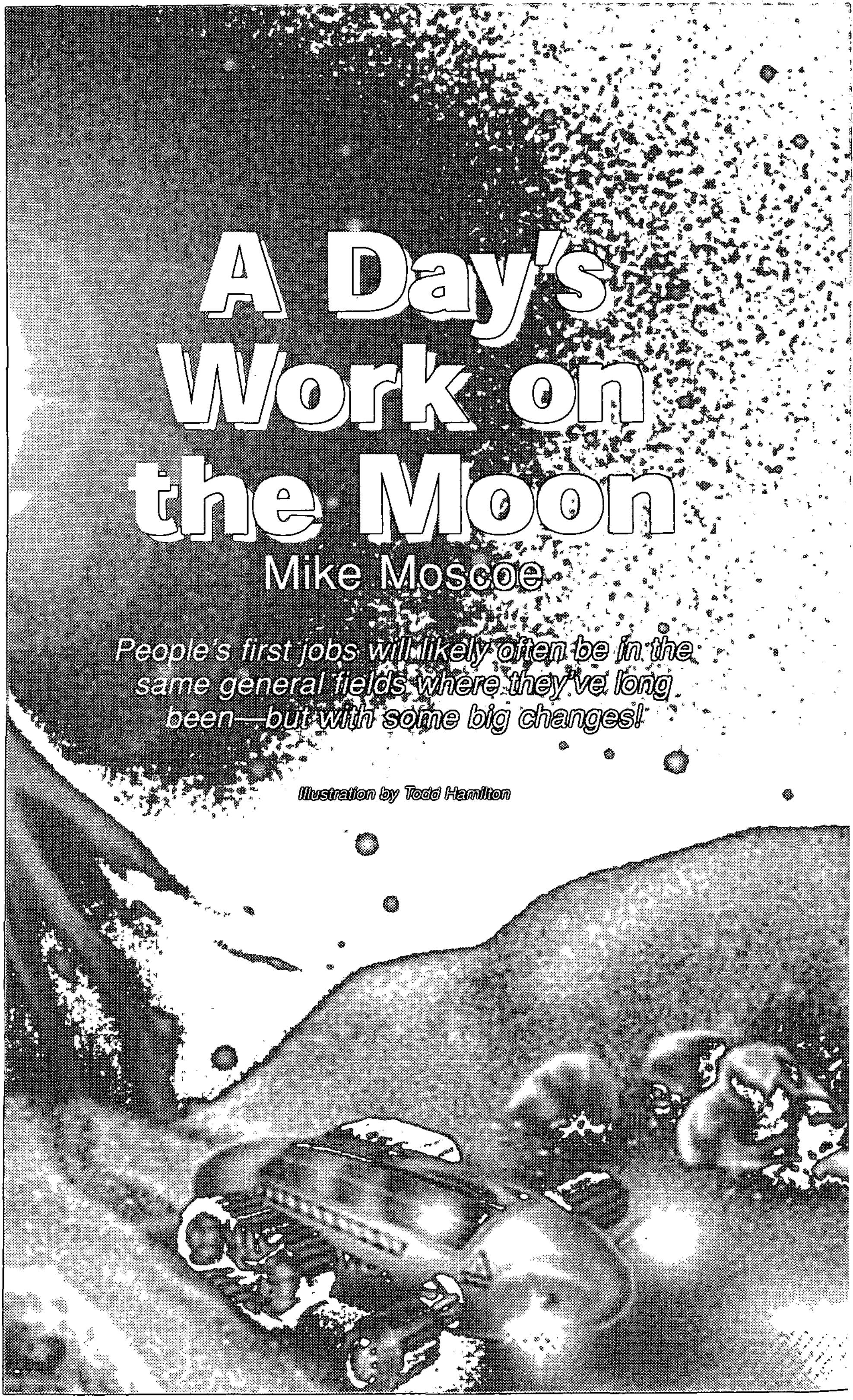


A Day's Work on the Moon

Mike Moscoe

People's first jobs will likely often be in the same general fields where they've long been—but with some big changes!

Illustration by Todd Hamilton

I just *knew* I'd work on the Moon, but, like, I never figured on getting a job there before I finished high school. So totally prime! I wasn't even bummed when it was only delivering pizza—it was on the Moon!

Really, Dad started it. I was playing a game, ignoring my room, all pink and frills, a ten-year-old girl's dream of a woman's world. I was almost thirteen and beyond that stuff. The game was a cool new one. I was slipping and sliding my way across a marsh, full of lizards, frogs, snails, and other threatened and endangered species. The idea was to avoid running over them while hunting the rogue robots that did. I got points for incapacitating the bad bots long enough for a repair crew to reach them and correct their programming. You lost points if you damaged the bots too badly. Totally ace.

"Good game, Nikki?" Dad asked.

I almost jumped out of my chair. "Great, Dad. Way cool sim. You can almost smell the flowers. Course, bummer, I don't have a VR helmet," I wheedled.

"Would you like to do it for real? Drive a real robot on the Moon?"

"Way prime," I shrieked. Everybody knew you could rent time on the lunar robot explorers puttering around the Moon. Anybody with the money could drive the bots when they weren't being used for science. Problem was, they weren't cheap. "How long could I drive it?"

"Would fifteen minutes be enough?"

I did the math. "Yes!" I was really getting a birthday present this year!

"First, you have to do the research." Dad slipped into lecture mode. "What moon rovers are available? Which one do you think would be the most interesting to drive and why? Pick a preferred option and a few fall back ones and put a report together for Mom."

Neat! Mom and Dad were treating this like a full-fledged project. I slammed out of the game and rolled into the net for research. My birthday was in two days; which rovers would be in daylight? Of the nine on the Moon, three were hibernating for the night. Two more were new arrivals and still tied up with science where they'd landed. One was nudging its way around Tycho Crater; that looked like the most fun. Two were in the lunar uplands around the seas of Nectar and Serenity. They might be good. Then there was the one shuttling across the south pole, measuring water. That would be my last choice. Then I checked the length of the waiting list. Duh. All were booked solid for the next six months—except the polar rover. I outlined the situation to Mom.

"What do you want to do, Nikki?"

"I'd kind of like to drive a rover before I get my driver's license."

"I'll sign you up for the water survey, dear."

My birthday party was at the local pizza parlor. I had a bunch of the girls over from school, as well as Jer and a couple of his friends. Dad seemed happy that the guys were so few. I think this whole moon rover thing was just his way to get me interested in something before guys started following me home. He was too late; Jer had been carrying my books since third grade, but there are some things you don't tell your folks.

Anyway, after I'd survived "Happy Birthday to You," in a dozen wrong keys, Dad took me over to the lame Vehicle Remote Controller, just a box with fakie wheels, a tiny 30-inch monitor, a joystick for direction and a pedal for the brake. Who needs a brake? Dad buckled me in—I needed a seat belt less than a brake—said "don't forget to point the camera up," and lowered the lid on the VRC. It still smelled like pizza.

Then the monitor lit up; I was looking at a gray, boulder-strewn field on the Moon. I slapped the joystick for speed, and a crater moved closer, faster. I flipped the joystick to the right. The entire scene changed. I made that little moon buggy do a complete turn and got a view of this entire huge crater with rocks and little craters all over inside it. I did a second turn before I realized I was just doing wheelies on the Moon like some dumb kid. But I wanted to see it all, over and over again!

I remembered to point the camera up. The stars were unblinking pinpricks against a vast, black sky. I felt so tiny. Then I turned the camera down. Water crystals sparkled in my tracks. I'd uncovered a rock in my wheelie—a rock that had been there since the Moon was made, just waiting for me to come along.

I put the rover in gear, going forward, like its mission plan said on the map in front of me. At the bottom of my screen some instrument reported water content of the dust beneath my rover. I was recording scientific data!

The rover was headed for an ancient crater where a real scientist would take over and do something really scientific. But for the moment, it was mine. I drove forever—and in only a second, the screen went blank. I just sat there staring at the gray monitor—and remembered how to breathe.

I wanted more.

After that, every spare ten bucks I could get my hands on went for another minute on the Moon. Luckily, grunge was making a comeback. Mom never caught on that I outfitted myself for school at the Salvation Army. Clothes money went for rover time. Lunch money too. Anything to spend another five minutes alone on the Moon.

Of course, I usually wasn't all that alone. Jer got hooked, too. He started designing us our own buggy controller so we could do our time right from my room. You could buy a Kopy Kat™ VRC with full emulation for $10,000, but my fourteenth birthday passed without even a party; money was tight. So Jer and I started putting one together up in my room from odd parts.

And found out that Dad had done some really interesting programming with the motion detector on the burglar alarm. When I was just a little kid, it felt real good to know that Mom and Dad could see anywhere in the house, especially the monster that hid under my bed. Later, when I was eight, and Mom explained to me how young women need their "privacy" and she was removing the camera from my room so I could have my privacy "just like her and Dad had," I felt very grown up.

"But I'll keep the motion detector on alert," Dad said, "so if any strangers come into your room, the alarm will go off."

At fourteen, I didn't consider Jer a stranger.

"Dad, Jer's lived next door since forever. We're just building a rover emulator. Why won't you give him full access to my room?"

"I thought Jer lived in our refrigerator," Dad said, giving Mom one of his sideways grins. So this was going to be a two on one talk. It was times like this I wish my folks had had two kids; that way at least it would be a fair fight.

"Honey, a young woman's room should be a private place for her."

"But where else can we put our kopy kitten-ulator? Dad's shop just swallowed the rec room for a spare parts locker. You've got the last bedroom laid out as a project management center. Maybe if we moved the dining room table out to the screened porch, I could set the VRC up in here."

"No!" They got that word out together. I expected they would. Dinner was a "sacred" time for the family to be together. Usually.

I won and I lost that night. The VRC stayed in my room, but Jer only got unlimited access to the ground floor. We had to keep our distance, and keep moving—but not too fast. Dad really did some programming on that alarm. I know; Jer told me. He tried and tried to get a work-around on Dad, but everything he tried, Dad had something there before Jer did. Bummer parents don't trust their kids more!

So there I was, fifteen going on sixteen, lounging on my bed alternately staring at the want ads and at the pink wallpaper, wondering if Mom was right and if I should redo my room different from when I was ten. I'd really rather use the money for rover time; Jer didn't mind how my room looked. He was sitting over in the corner by the skeleton of our kopy kitten, in the cast-off chair from the living room, his nose in a reader doing homework. I couldn't make up my mind. Do I want a job to pay for my own car insurance or more Moon time? Mom would make me save some of the money for college. Jer's grades would get him a scholarship; mine might get me in. Then I spotted the ad from Artemis, Inc. and sat up.

"Hey, Diana Base is looking for a fast-food delivery person. Why would a high-tech place like that want a delivery girl?"

Jer glanced up from his chair. It was as close to my bed as Dad's latest algorithm would allow. "Someone's got to keep an eye on those dumb robots they got up there."

"And some dumb barney they pay minimum wage is going to be smarter?" I shot back.

"They aren't going to hire any stups, Nikki Ann." He was talking at me like he had the time I couldn't get the concept of the number eight. I'd bopped him over the head then with my reader, but I wasn't three years old anymore. I had new ways to take him down a notch.

I stretched out on my bed, hands reaching for the headboard, back arching. His IQ plummeted as he tried to ignore my silhouette, nicely augmented by the two new friends I'd developed straining against my tank top. Who said it wasn't nice being a girl? "So, what are these non-stups going to do for their minimum paycheck?"

"Uh . . . take care of the bots," Jer stammered.

"Not maintenance!"

"No," he blinked, gave up, starred, then came back to the word fight with a vengeance. "Weight is gold on the Moon, lunkhead. They don't want to warehouse a lot of spare parts and maintenance people, so they ship up the toughest, dumbest machines they can get with the longest mean-time-between-failure, and let some earthbound bunny do the thinking for it."

"I could do that." I said, and highlighted the number in the ad, pulled up the resumé they'd had us do in school, appended that I had over 350 hours in a Lunar Rover, which was a lie, and sent it. "Wonder when I'll hear from them?"

"Shouldn't take too long," Jer said. "A routine ought to be able to check out your resume in no time. Too bad you couldn't put down all your Rover hours." The three hundred and fifty hours were only the ones I'd signed and paid for. Jer had almost as many hours, as did several kids at school.

But one of Jer's first big hacking credits was breaking the lock on the rover. Now, when one of us rented time, all of us got to ride along. Jer had also figured out how to store the file so we could ride it again as many times as we wanted. Going backseat on someone else's ride, or an old ride wasn't as much fun as realtime, but it was still time on the Moon as far as I was concerned.

Of course, storing all those vector images was almost a stumper. You couldn't tell your folks you needed a couple-of-thousand-terabyte array for your birthday to store pirated images. So we went totally creative.

There was lots of spare disk space around the house. Nearly half of the house management system's drive was empty. Mom never used all the cooking options in the microwave; we dumped over half of them and she didn't miss one. We'll never own a Cashmere sweater, so I got rid of a lot of the washer/dryer settings, too, and loaded up images. Jer and I couldn't walk around either of our houses without bumping into image data, but grownups didn't notice a thing. Duh. I think everyone over twenty-one is blind.

It took over a week for the Artemis people to get back to me. The woman who called wasn't too old; she couldn't be thirty. She liked my resume. My moon buggy hours seemed to impress her. "Do your friends ride a lot?"

I rattled off four who did, "But I have the most hours."

She smiled at that and asked about my access to a computer. I sent her a download of the Vehicle Remote Control system Jer had built for me with its latest updates and additions. That earned a raised eyebrow.

"Quite a rig you have."

"We built it ourselves. Well, actually, Jer, my boy . . .ah, the guy next door, built most of it. He'll fix anything that breaks."

She looked at me, big smile on her face. "I bet he will. Here's a number. Dial it tomorrow at 1:30 A.M. GMT," she glanced offscreen, "that will be 5:30 P.M. your time, and you start work." I didn't tell her I knew darn well what GMT time it was here. Rovers ran on GMT. I was too happy at the moment to take the time to straighten out a grownup who thought I was dumb.

I called Jer on our network. "I got the job! I start working on the Moon tomorrow after school!"

Next afternoon, on the walk home from school, I wanted to celebrate. Jer suggested a milkshake. "Naw. That's here and gone. I want something I can keep." I headed across the street, dodging traffic, Jer dodging right behind me. Some old timers in a fifth wheel rig were laboring up the hill, we squeaked across just ahead of them. The gray-haired lady driving just shook her head as she went by. I laughed.

"Where are we going?"

"The Teddy Bear Factory!"

"Not again."

"And what's wrong with a cute, cuddly little teddy bear?" We'd had this conversation before. Many times before.

"Nothing, if you're a girl."

"And what's wrong with a girl?"

There, I had him. Didn't used to. But the last couple of years, that was the winning line. Well, not always. Sometimes he'd won with "You're not going to waste money on fluff that would buy rover time." He was quiet today as I eyed the different furry options. They were so cute. I'd just die if I ever found a bear in a spacesuit—on a rover.

"You know, maybe you could buy one today. You know, to celebrate."

I grabbed his hand, felt for a pulse, then brushed my hand over his forehead. He didn't pull away like he used to. "Help, police! Some aliens have stolen my friend. Jer would never say something like that."

He ignored my carrying on, stuffed his hands in his pockets, and explained himself. "Well, you know, if you're working for Artemis, you're jacked directly into their system. If the locks aren't too tight, maybe I could get a hold of the downlink from the rovers. Go direct to the source."

"You mean we could have it all!" I screamed, pulling him into a hug.

"I think so." Jer actually turned red. I gave him a kiss and he got redder.

"Let's get home. Make sure everything is ready. Race you." I won. He's the brains of the act; I'm the muscle. My system came up without a hitch. I was ready fifteen minutes early, so I ran an old rover drive while I waited. At 5:29 sharp, I dialed in, ready for anything.

I got a flat video. All kinds of dumb stuff on how I'd get paid, (slow and not much), what my benefits were, (none), how I'd have to have my school report card copied to them. They had a reward program, extra money for good grades, a bonus on top of that for honor classes. What do you know, Jer's pushing might actually make me a few extra bucks. Only after I passed a test on that junk was I allowed into the interesting stuff.

And that was a disappointment again.

They were starting me out as a cook!

They had a cook-bot that made the pizza and stuff from scratch. Most of the ingredients were still lifted from Earth, but the flour was moon-grown. My job was to take the orders and see that the bot didn't waste anything making them.

Somebody else got to oversee the delivery-bot.

"I think you have to get promoted up to delivery," Jer said. "Didn't you see that part in the employee briefing?"

I'd missed that.

Bummed, I spent four hours in my bedroom making sandwiches, pizza and whatever else was ordered by the crew that really worked on the Moon. I didn't see anything I couldn't have seen standing at the counter of the local Pizza Heaven. Big bummer.

Still, I didn't let that bother me. Jer was at my elbow, his reader plugged into my station, tapping away at any outlets the program gave him. He didn't hit pay dirt that first night, but he was pretty sure he would. "Your Dad's using tougher lock-outs than they do." Probably because they trusted their employees more than Dad did me.

Still, it took Jer the better part of two weeks to get all the way in. Every time he'd get past one lock, he'd hit another. "This is more fun than a game," he muttered as I watched bread rise and two pizzas bake. It was just a job. The third week was when it got interesting.

I got my paycheck and Jer cracked into the rovers. To keep Mom happy, I put half my check into the college fund. The other half went for two monster hard drives. While I cooked, Jer downloaded for all he was worth. By the second shift, we started dual operating. Jer set up some simple alarms on the oven and cook-bot and I watched them on one monitor screen. On the other three monitors, we started touring more of the Moon than we'd ever seen before. Not all the rovers are available to rent. Usually the newer ones are still knee deep in science where they were landed and not yet really roving. We got that feed. I got to where I could take an order and get the bot going on it without taking my eyes off of the real Moon feed. It was great.

Then we hit a problem.

It really wasn't our problem. I mean, my job was going great. But it was sunny down in California, and the surf was up according to the weather report Jer called up. Anyway, my delivery driver must have headed for the beach, cause he sure wasn't on the job. It's Friday night on the Moon, and all these folks just want to kick back. I'm cooking like mad, and the delivery bot is sitting out there—totally parked.

So I loaded it up and took it for a spin around Diana Base. And discovered why you had to be checked out on that dang thing before they'd let you drive it. Knocking on doors and delivering the stuff was no problem. Getting there was not fun.

Like everything about Artemis, Diana base was being built on the cheap. To get as much air and dead space between the people and radiation from space, they were digging the base down as far as they could; I learned that in school. Driving around the base showed me what that meant. On the surface, under the bubble domes, things look spacious. Once you get underground, it's cramped. If you don't watch your bot every second, it can run into things. The map is a help, but they're changing things all the time, and a pile of crates or a parked construction rig may be blocking what looked like the fastest way from here to there.

I had to really think about where to drive that bot. And you better not run into anything. I almost did a couple of times when I misjudged how wide the space was. Scraping against a wall would be just a matter of paint. Knocking over a couple of boxes, even in Moon gravity, made a mess and might break something. I was careful.

An hour into my shift, my supervisor showed up apologizing about her beeper batteries being dead and I guess ready to take the delivery bot out. I heard a surprised little "Oh," when she saw where it was.

"Who's doing the cooking?"

"I am," I assured her. "I've got alarms set, and when the delivery bot's in a safe stretch, I do a quick look around the kitchen. Everything's fine."

Her "We'll see," sounded like one of Mom's more dubious ones, but after five minutes, she was back. "You *have* gotten things under control. I like your alarm routines. Do them yourself?"

"My friend, Jer, did them for me. That's okay, isn't it?"

"So long as you're doing your job, I have no problems. Neither does Artemis. I think we have a vacancy for a driver. Let me brief you on how it's done." So, for the rest of the shift, I learned her tricks. She kept her own map of Diana base, updating it constantly with a little routine that showed which passageways were temporarily blocked, which had been permanently changed, but not yet entered into the main map, and where you might be able to slip by. She even had a shortcut that took her through one of the labs. "Be real careful if you do that one. Sometimes they work late. Until they've ordered something, don't go in there. But once you've delivered to them, they'll usually let you cut through. Gary, the supervisor there, loves flat bread, so if you've got any spare ends, and he's working late, drop him off the ends and you'll have a friend for life, or at least the rest of your shift.

The things you have to remember!

I got a promotion, and a bonus for my double shift. Jer and I spent the bonus on one of those new seats. You're riding around the Moon, going up, down, riding over a little crater, you can see the camera jarring, but the seat under your pants is still acting like a chair in your bedroom. This new seat changed that. You go up, it leans back. You go down, it leans forward. It bumps when the rover bumps. It was almost perfect.

But not quite.

"Mom, I really need a helmet. One that'll let me see all around."

"Well, dear, save up for it."

"I've almost got enough. If I didn't have to pay into the college fund this month, I'd have it."

That brought Mom out of the project completion schedule she was updating for an insurance company. "Honey, we agreed that half your check went into savings."

"I know, Mom, but if I put all of next month's check into savings, I could be using the helmet this month. Some of the scraps I've been in 'cause I didn't quite have as much clearance as I thought won't happen when I have a helmet." Mom and Dad should understand that. They were all the time upgrading their systems to stay competitive. Rarely did any of the people they contracted with pay for an upgrade; still, they were always happy to make use of ours.

I could tell from Mom's look I'd won. I gave her a hug and headed back up stairs. Jer had been comparing helmets, searching the net for the best one for me. When I'd left he'd narrowed it down to three.

"I think you ought to buy this one," he said as I came back in. He'd never doubted I could talk Mom around. "Both these come from the same factory in Burma, but this one has Indian software. It's a lot cleaner."

I ordered it. When it arrived, Jer had a ball improving it. The seat also wasn't nearly sensitive enough for him. He improved it, too. He swore now that if I drove over a dime, I could tell if it was heads or tails. I could sure feel the bumps in Diana Station where they'd added this on or dug that new space. I bet the people up there were all the time stumbling over things.

Of course, the newest wing, where

they'd put in the honeymoon suites and the space camp for rich kids was all first class. Wide, uncluttered corridors were painted anything but dull gray. It would have been a fun place to drive if the kids weren't so chintzy on their tips. The newly married couples almost made up for that. They were a lot of fun to deliver to. Which got me thinking of Jer in ways I'm sure Dad wouldn't approve. It would be fun, honeymooning on the Moon. But we could never afford it.

I concentrated on missing a new pile of crates.

Between the helmet, the seat and Jer's refinements to both, I had an emulator that Kopy Kat would eat their hearts out for. I was in heaven. All the delivery bots and the new rovers have fixed cameras covering 360 degrees around them. With all three monitors in front of me slaved to the forward camera, I didn't know what was behind me. And it really took the fun out of the ride if I switched one for a rear view. I wasn't driving a bot, I was just some security guard, looking at three different pictures.

Not with the helmet. You glance over your shoulder, and the view switches from front to back like it should. At least it did after Jer did a few enhancements. You look up, you see up. Ace, so ace. I got to where I could move that delivery bot around the base like it was me on blades. In the new corridors, I could take the corners so fast, the bot was on two wheels and the seat let me feel it. One of the guys in the lab put a decal on my bot. "Rocket Girl." It had a cute blond astride a rocket with the cratered Moon in the background. I just said thanks a lot and didn't tell him I was a redhead.

Jer made me a picture of Rocket Girl and hung it on our kopy kitten. His "Rocket Girl" was a redhead.

Everything was going totally great. So how come, after my Friday shift, I find a message to call the woman in Personnel on Monday after school?

"I haven't done anything wrong."

Jer nodded agreement.

"They couldn't have found out about your downloads."

Jer really shook his head at that."

"Well, then why do they want to talk with me?"

"Maybe they want to promote you again. Maybe you busted something. Maybe they want a real picture of you so they can do Rocket Girl right."

I slugged him for that one.

It was a long weekend, and Monday at school went forever. I wanted to run home. Jer reminded me that I didn't want to sound breathless on my call. Our walk took us by the Teddy Bear Factory.

When I was a kid, I used to walk in the paw prints some big black bear had left on the sidewalk. Or so my Dad said. I'd walk in them and they'd make me laugh. Now, they were so close together, my shoes reached from one to the next. I walked in them, but they didn't make me laugh.

Jer tried to tickle me. I slugged him. He dodged, and came right back in to tickle me. Between swinging at Jer, and dodging tickles, and not always dodging them, I found a giggle. We ended up laughing together. Oh, Jer's fingers could make me feel good, and not just where he tickled me. I guess we were growing up, closer to that honeymoon suite than the little girl walking in the bear footprints. We headed home, his arm around my shoulder. He was good to lean on. "Everything will be fine," he kept telling me. Most of the time his voice didn't break and I could believe him.

I sat in my kopy kitten for a couple of minutes after I got home, breathing slowly, reminding myself I was a high school student who worked on the Moon. Jer slumped into his chair and pulled out a reader, but I don't think he did any studying.

I dialed. The woman came on immediately. "I'm glad you returned my call so quickly. How would you like to work outside on the Moon?"

I sat there, staring at her, suddenly needing to catch my breath all over again. Jer leaped up from his chair, did a little victory dance ending in a shouted, silent "Yes!"

"Ye . . . Yes," I stammered.

"Good. I thought you would. Your supervisor hates to lose you, but, she figures with all you've been investing in your system, you could use the raise. We're opening up a new dig. It's further out from the base. The regolith is rich in aluminum and titanium. You'll be getting a new dozer. Can you start tomorrow?"

"Yes, ma'am."

"Can you, or the boy next door, give me a new download of your system? We have to make sure there're no incompatibility problems."

Jer raced over to help me. That brought him in view of the woman. "Hi. You are?" she asked.

Jer introduced himself. I was glad he was with me; his enhancements of the standard codes raised a red flag. "Normally, we prefer you to reinstall the original software. That's what we qualified for the equipment. But I know a couple of guys at the lab who'll probably take it as an honor to double-check Rocket Girl and her faithful sidekick's mods. We should have it checked out by the time you get home tomorrow."

She signed off, and Jer and I started dancing around the room. Dad's alarm when off. It shouldn't have. We were close, but we were moving all the time. We bolted for downstairs, to tell Dad the good news and have him reset the alarm system. Dad was still in his shop in what had never been the garage, hunched over a new chip layout.

"Dad, I got a new job. I'm driving a dozer. I'm out on the Moon," I shouted, laughing.

"I knew you would, hon." He looked up, frowned, listened for a second. "The alarm's gone off. Would you go reset it, Nikki. You know the code."

Jer and I headed for the hall closet. The door to Mom's office was closed. I edged it open and slipped my head in. Mom was on the phone. "Dear, could you reset the alarm?"

I did. Maybe my folks *do* trust me.

Driving a dozer on the Moon is totally ace, not at all like driving a delivery bot. Dozers are the biggest, heaviest, most massive piece of equipment that we've shipped to the Moon. You do not take one of them around a corner on two wheels, or more correctly, one tread. Dozers push, pull, drag, drill and mangle regolith. But, since we don't ship anything to the Moon that is any heavier than it has to be, you have to be careful how you push, pull or mangle that regolith, because even a dozer has limits.

Rocket Girl needed a whole new set of sensor feedback subroutines if she was going to be Rock Girl, or Rock Woman, or Rocks-in-her-Head, as Jer suggested, which got him punched. He didn't see that one coming, so for once I did bang him good. So I kissed it to make it well and that took a while, but we got out of the clinch before the alarm went off.

I got busy learning my new machine, and Jer got busy making our kopy kitten better. The big worry for the dozers was pushing or lifting too much in the Moon's weak gravity. If you weren't careful, you could put your dozer on its back. It took time to right you, and your solar collectors usually got damaged. I would be working further out than most, until a second dozer of the D-4 series arrived. Having the first of the D-4's on the Moon was a surprise. I asked why they didn't give it to someone experienced; all of us on the D-4 were new. "Why retrain someone who'd been doing great with the C-3? You might as well learn dozers and the D-4 at the same time." So a couple of dozen of us got the newest toy on the Moon. We also got a full time supervisor to kibitz us for the first week.

Jer didn't mind. He was working on improved feedback loops, something to warn me ahead of time that I was biting off more rock than I could chew. The Moon is close, but when you're lifting too much into a hopper, a two-and-a-half-second delay can do a lot of damage.

But there were benefits to working outside. Have you ever seen a shuttle take off from the Moon? That was something that a wandering rover never caught. I was right under the path for takeoff. Jer cut me into the traffic control channel as soon as I accidentally spotted a shuttle on takeoff. After that, we'd monitor takeoffs and landings; Jer even set up a plot that showed me where to look.

That's how we knew something was wrong even as it was happening.

Nothing on the Moon is silent. My dozer has to talk to me, not just for go right or lift that load, but to tell me what the wear is on the tread so I can call for maintenance before it breaks down. There's a lot of telemetry buzzing around the Moon from anything that's moving. A lander sends an encyclopedia every second. When one quits, the silence is deafening.

"Shuttle five-oh-three, say your status," was not an unusual call. Jer and I factored it into the background. "Shuttle five-oh-three, say your status, we have lost your signal," brought both of our heads around to the comm monitor, me dimming my helmet so I could see the monitor as well as the chunk of Moon I was pushing toward a hopper.

Jer tapped his board several times and most of the communication data disappeared. Traffic Control stood out like a skate-board with three wheels. Three lines crackled with data from lifting and approaching landers. One line wasn't straight. It just wasn't there.

"Did it crash?"

Jer tapped a few times, then shook his head. "No recorded seismic activity. It's still up there, just no signal."

"That's impossible. There's got to be some kind of signal." Dozers and delivery bots might be cheap hunks of dumb metal, but everything man-rated had backups for the backups for the backups. And even those had redundancies built in. A shuttle couldn't just go silent.

This one had.

I checked my dozer. It wasn't in any great risk. I gave it half my attention while the other half was drawn into this drama. It had been five years since the Moon killed anyone. The understanding was that anyone on that lander was there because they wanted to be there. Hell, if Jer and I had a choice, we'd be on that lander. I'd still swap with the people on it. They had a problem. In a minute or two, it would be solved.

The minutes started to stretch. Radars that swept the final approach were redirected to cover a wider search. Someone posted a fuel remaining readout. Landing time became a widening band around the ever-lowering estimate of remaining reaction mass. Jer and I watched without saying a word. Jer lit up all the old monitors we'd retired when I got the helmet, putting different readouts in their windows. Seismic was in the center; if the shuttle hit hard, that would be our first report. Radar, time remaining, somebody's mad search for a boarding list for 503, lots of things was going on. Jer cycled through most of them, selecting the ones we should monitor. We watched, hardly breathing.

The pessimistic estimate of fuel on board came and went with no seismic report. The middle one passed, too. Had they managed to abort to orbit? Could they be found up there, rescued? That might be worse than hitting hard. There was a slight blip on seismic before the optimistic fuel guess hit bottom.

"I think they're down," Jer said as someone in Traffic ventured the same guess.

"Where?" I was echoed from a dozen different stations.

Jer just shook his head. "I don't know," came from a monitor. "Seismic?"

"We have an event. It probably was them . . . ah . . . landing. It's pretty faint. We've got a circular error of probability over twenty miles wide."

"Where's it centered?"

"Right over Diana Base."

"Shit," was a grownup's comment. Jer and I echoed it.

"Why's it so weak?" I asked.

Jer shook his head. "Maybe they hit light. Maybe they hit glancing. Maybe the rock they hit or some rock between the recorders and them doesn't carry sound so well." Jer shrugged. "The seismic stations weren't designed to locate crashes."

"What do we do?" I bet a lot of people were thinking that.

Jer just shook his head. "There's nothing you and I can do. If someone sends your dozer out to search, you go. Otherwise, I guess you move rock."

I checked. Yeah, I was ready to dump this load into the hopper. I did, then turned the dozer back out to find another bit of Moon. While I did that, I did a full maintenance review. D-4 was as ready as she could be.

"Help us. Can anyone help us?" A girl's voice came from one of the commercial channels. Her portable computer's camera must have lost its auto-focus. She was a blurred image in the near field. I tried to make sense of it.

"She's in a spacesuit!"

Jer ran a filter program. Yep, a girl in a pretty pink spacesuit; the helmet had an expensive starburst logo on it.

"Who is this," came an urgent voice.

The first name I didn't get. The second was known through out the world. Her Dad could afford to send her to camp on the Moon. Hell, he could damn near afford to buy her the Moon.

"Where are you?"

"I don't know. The lander did all kinds of crazy things before we hit."

"Is your hull breached?"

"A guy had his face plate smashed. He's dead."

"Stay on line. Help is on the way."

"I'll try." And her signal vanished.

"Where'd she go?"

"It was a miracle her computer survived as long as it did," Jer muttered, rewinding the scene. "Where are you, kid?" he asked the monitor.

"They can track the signal."

Jer waved at the monitors. "They're trying. They only have three relay satellites. Only one was overhead when they got her message."

"So?"

"So, the cell phone on her computer could have been anywhere within one hundred and fifty miles of Diana Base."

"Oh. That's no help."

"Yeah, but maybe this is." Jer had pulled up the backdrop of her picture. It was in focus. Through a rip in the lander's skin two mountains stood out. One had a pair of craters half way up it that almost looked like eyes. The other had twin peaks of equal height.

"Seen those before?"

"I don't know."

"Neither do I, but we've got an awful lot of rover video. We can limit the search to twenty miles of Diana base."

"Forty," I said. "You don't know whether her camera was aimed in or out."

"Fifty it is." He did a quick search on our database of pirated rover video. "Looks like we got most of that ground covered. I can do a simple match, easy code with no risk I'll blow it, but we'll need a lot of computer power. Do you think you could. . . ."

"Ask my folks!" That would mean telling them what we'd been doing. Where we had it stored! Everything! "What about your folks' computers? They're not home."

"Our home computers are lame. I'll use them, but your Dad and Mom's are the real power here. Beside yours."

D-4 was headed out. It wouldn't need a baby sitter for a few minutes; I raced down stairs. "Mom! Dad!" I shouted.

"We have to talk. It's a matter of life and death—and this time, it really is."

Even with that for an opener, it took a while. I had to drag Mom out of her office down to Dad's shop. Whose daughter was lost on the Moon got the kind of sad parent nods I expected. Then I took a deep breath and told them how Jer and I might be able to save her.

Dad nodded. "Good approach. I wondered why the house system took so long to cycle from winter to fall this year. Should have suspected it was a full disk."

Mom's eyes just got big.

Dad headed upstairs, Mom and me following. He didn't juggle Jer's elbow, just looked over his shoulder, lips tight and his mouth getting smaller as he chewed on his lower lip. Finally Dad nodded. "Good code. Download a copy of what files are where. Honey, network speed is going to be a problem here," he told Mom. "You set up a schedule for shipping the files over the net. Things will work faster if all the files a computer is processing are on it when we kick it off. I'll go see how much disk space I can create on each system."

"Yes, love." Mom headed down stairs without even a glance back.

No matter how long you live with people, you will never guess what they'll do next.

For the next hour, I went back to moving regolith. The search centered on the other side of Diana base. The main assumption was that the shuttle had lost attitudinal controls but the pilot had succeeded in steadying things down and used the last of his fuel to land them somewhere in the approach path, so most of the search units were there. Dad and Jer agreed that since it had stayed up past its usual fuel limit, it had probably kicked itself up and gone long. The gentleness of its landing bothered both of them. Mom biased the search for long and I edged my dozer out as far as I could put it.

"Dozer D-4, join the search. Swing wide and search to the south. A map appeared on my heads-up, a blue-hatched area marking out a large chunk of landscape to the south and east. I wanted to go west. But I could go south for a while.

"I will proceed down Claudette Valley and cross over at pass 4R."

"Do it."

I did it as slow as I dared. "Jer, I've been drafted into the search." I showed him where. All he did was frown. "Mom, can you speed it up any?"

"No, honey, the poor 'puters are chewing as fast as they can."

"I'll start dumping negative files," Dad put in. I reviewed my status board. D-4 was cool, ready for anything. The sun was getting low. I edged the solar collectors over as far as they'd go. When the sun was down, D-4 would recharge from central power. That kept us fairly close to base. During the day, I had more freedom to pick and choose my rocks. If they'd crashed twenty miles from the base in a few more days, there was no way we would have been able to search for them.

"I've got a hit," Mom shouted

"We found them," Jer said, fingers flying over his keyboard. A new window opened up on my heads-up. A pile of rocks filled it, looking nothing like what I'd seen in the background of the girl's message. As Jer's fingers clicked on keys, it rotated. There were two eyes on one of them. And yes, the other mountain divided into two peaks.

"You did!" I yelled.

"But where?" Dad and Jer muttered in the same low voice. The mountains settled onto my map, a line extended from them, going longer and longer. I checked. Exit 3L would get me headed that way. I gunned my dozer, moved the tread condition window up where I couldn't miss it when I looked out, and reangled the solar collectors to correct for my direction. I figured I had five, maybe ten minutes before my new course was noticed.

"Dad, you better call the Moon."

"I've been trying, princess. All the circuits are busy."

Who else could I call? I punched the number for the woman in Personnel. It was answered almost immediately.

"I'm sorry, I'll have to call you back."

"No! This is Rocket Girl and we've found the lost lander."

Her jaw gapped. "You found them?"

"Billionaire's daughter and all. It was lander 503."

"Yes. How?"

"We matched rover images from the Moon against the background in her picture."

"You what? You couldn't. . . ." She glanced away from the camera, her face a puzzle. "You, and the boy next door. You'd need a lot of video."

"We've got it."

She was running her finger down something off screen. Her head began to nod. "You probably do. Yes. I'll get back with you in a few minutes. Stay close."

"I'm on shift."

She glanced off screen again. "Not for long."

I'd been ignoring the clock. Looking at the seconds ticking away made me think of oxygen going stale. Oh lord, I was almost off work. "Please, get back soon."

She was gone. I concentrated on driving. Now was no time to pitch into one of the little craters or smash a tread on a rock. I upped the magnification on the forward camera, edged the side ones around forward as far as I could.

"Hi," came the cheerful voice of my replacement. "I'm here. You got a date tonight?"

"A lander's down. I think I know where. I've got to keep working." I shot back.

"I heard about the lander crash. Have they hauled even the D-4 into the search?" She hadn't heard me.

"Listen, my boyfriend and I figured out where they are. I'm headed there right now as fast as I can put treads down and pick them up."

"You're Rocket Girl."

"Some people call me that."

"They told me you were good. Can I come along?"

"Don't juggle my elbow." She didn't answer. Smart girl.

"D-4, you are off your course. Get the hell where we told you to be."

"This is Rocket Girl, I've found the lost lander and I'm going to get them."

"Oh shit, kid, your shift is over. You're out of here. I'll see you fired later. Where's your replacement?"

"I'm here, sir," came a timid squeak.

"Take over."

"She will not take over. This is Rocket Girl's Dad. I have been monitoring this rescue effort as well as my daughter and her boyfriend's effort. We have a 95 percent probability of having identified the crash. You pull my daughter off this and you are signing the death warrants for six people."

Dad didn't say who. Dad is good when he gets definite mad—so long as it's not you he won't let go to a band concert. I dodged a rock, aimed around a slight hillock. My speed was edging into the red on both tread and velocity.

"Wait one while I talk to my boss." The voice from the Moon cut off. I drove.

"This is Rescue control. I understand I have Rocket Girl and company on line."

"I'm her father."

"Personnel just passed me her file. Your kid has accessed a lot of controlled video. Were you aware of that?"

"Not before today. I'll ground her tomorrow. For now, we got some people to save."

"Don't ground them," Jer and I exchanged a hasty glance at the plural. "Every one of the guys working for me cracked our lock-outs when they were kids. I wouldn't have hired 'em if they hadn't. You ran a search on that imagery."

"Yes. You can check Jerry's code later. For now, I'm passing you through the results." Dad waved at Jer; he started tapping. The search results reappeared on my heads up. I passed them up to the Moon.

"Damn, that is the backdrop. Why didn't I think of the background. Too damn long since I spent some time on a rover. Folks," he hollered, "turn those rigs around. We're headed in the wrong direction. Where do you think they are?" he asked in a normal voice.

"Somewhere along that axis," Dad said.

"But where? I'll have a satellite overhead in about five minutes. We've got it ratcheted down to half meter pixels. Nice picture but not very big. Any suggestions?"

I stared at the picture. The girl would probably have the latest computer stuff. Camera was probably as good as the one on the newest rover. I called up the height of those mountains, gauged their base against that, tried to estimate that against some of the distances I'd driven on the rover—No, on the D-4.

I took a stab at the monitor's map. "Somewhere around there." Jer shot him the coordinates.

"That is where we'll take our picture," came back.

I kept picking up treads and putting them down. It was time to climb a hill. I took advantage of a shallow valley to put my speed well into the red. D-4 was a good old girl. I could hear her throbbing under me, shaking my seat just a little bit. "That last upgrade's working real good," I smiled at Jer. He grinned back. D-4 was a greased skateboard. I was rad. We were one.

My hands were starting to tire, and my back was aching when the photo flashed on my heads up. It was in stereo so I could see the hills and valleys. There was a long streak down a hill, ending with a wide swath where the shuttle had rolled sideways the last hundred yards.

"He ditched it on the downside of a hill," Dad's voice held solid admiration.

"That he did," said Rescue Control. "We make out four sets of footprints walking away. They were here," a circle appeared on the picture, "when we were overhead. If they keep walking in that direction, you should meet up with them about here." That was an X.

We were covering two long sides of a triangle. "Would be better if we met in the middle," I said.

"We can't raise them."

"Maybe I could get their attention," I said. When you work around Moon dust and rock, you learn not to make it fly. The less in the hopper, the less that goes back to the refineries. But when you're learning, it takes a bit of getting used to. I thought it was kind of cool to make the dust fly until my supervisor pointed out the economics of it.

"Jer, plot me a line of sight to them."

It took him a minute. "It looks to me that when you top the next real rise, they might be able to see you." I'd never heard Jer so circumspect. Then, this was the first time lives depended on him. A moment later, "we concur," came from Rescue Control.

I only wanted a little dust in my hopper, definitely no rocks. I couldn't slow down to collect it. Little by little, I lowered my front loader. The readout said I picked up a little here, little there. My seat was rocking as I went along. Seat and front-loader cargo load agreed. I lifted the hopper when I had about a kilo of dust. Going up the last few meters to the crest, I gunned it, trying to coordinate putting the loader against its top stop just as I bounced over the ridge crest. With luck, I'd just sent up a dust plume only a blind man would miss.

There was no way to know if I had.

Next highpoint, I did the same. I paused after sending off my dust signal at the third highpoint. While my solar collectors drank in what they could of the setting sun, I searched ahead of me. It didn't look like they were where they would have been if they'd just kept walking. About where they might have been if they changed direction on my second signal, I picked up a long line of dragged feet down a hillock. The line pointed right at me. I took a bearing and floored it. D-4 bucked and shuddered under me, but she went.

"How long?"

"Maybe a half hour," came from Jer and Rescue control.

"How long before someone else with oxygen gets here?"

Jer shrugged. Rescue didn't answer.

They were a dusty, bedraggled group that D-4 rolled up to thirty minutes later. A slim figure in a pink spacesuit did an excited jump, hands clapping, followed by a slow landing. I hoped someday I'd get to meet her. They stared at D-4 like it was something out of a dream. D-4 had never been designed to be ridden. Maybe I'd just lead them back.

However, D-4 did have to be worked on, so there was a plug-in for a diagnostic computer. Pink spacesuit had not ditched her pet computer, but plugged it right in.

Her "Is anyone there?" was plaintive.

"The whole world, honey."

"Daddy!"

"You didn't think I wouldn't be?"

"Daddy, we're low on oxygen and these suits are hot."

"People are coming. They'll be there real soon. How long have you got, baby ducks?"

"Forty-five minutes. Maybe an hour."

I glanced at Jer. He'd started tracking rescue assets. He had them arrayed on a screen as green triangles. They looked awfully far off. He looked up at my Dad. The two of them shook their heads. "Two hours, hour and a half at best," Dad said.

A shudder went through me. These people were going to die. I would sit here safe in my Mom and Dad's home and listen to a girl my age gasp for air while her Dad, who loved her as much s mine, had to listen helpless. This was not why I wanted a job on the Moon.

"Baby, that machine that found you. You could ride it. It would bring you closer to the rescue teams."

There as a quick shake of the pink helmet. "Dad, the pilot died getting us down. I watched a passenger die, too. We are not separating. This is not one of those times when having your name makes me special. It's all of us, or none of us."

Behind her, three standard-issue spacesuits had their helmets together, talking. Pink suit backed away. "I won't. It's all of us, or none. I'll run away. You can't make me."

"Enough of this horse-pucky," I shouted in what I hoped was a grown up voice. "This is Rocket Woman, and I run this track you're hanging around. All four of you pile on."

I checked the sun. It was down for the next two weeks; all we had was earthlight and stars. "You can rip off the solar cells, or ride on top of them. They ain't gonna do us any more good this trip. Baby ducks, you ride in the hopper. Doubt if you'll unbalance me much. Come on, get a move on."

I guess I did sound grown up. They moved. I started powering down everything I didn't need: head lamps, running lights, rear camera, side ones, too. Any diagnostic that wasn't a showstopper, off. Jer helped. Only those that gave me a feel for the ride were kept on.

Under the weight of four people, D-4 drooped. I put her in gear slowly. My skateboard waddled. Relying on only the front wheels to give me a feel for the bumps, I turned off the rear system. It had to move to get juice now.

I followed my trail back. That made things easier since I was three-quarters blind. My eyes kept flitting to the larger map. Where was I? How close was a rescue team? One was pulling ahead of the other. Probably had a driver as crazy as me. Or maybe they'd been ordered to push now and ride home with someone else. I didn't hear the message. I didn't need to know.

I concentrated on "feeling" D-4 and what lay ahead of us.

"Listen, Rocket Woman or whoever you are, I've got to talk to my daughter." It was pink suit's dad.

"Mister, I've turned off everything that doesn't make my tracks go down and up. That includes voice radio. Do you want to see her again, or talk to her now?" I couldn't believe I said that.

Dad rested a hand on my shoulder, squeezed. Mom was crying.

If I didn't pull this off, I'd try to save enough juice to let them talk at the end.

We topped a rise. It was dark. A long downhill run was ahead of us. I could power it, or. . . . I popped on one headlight and eased up on the throttle. With all the extra weight, D-4 picked up speed fast as it headed downhill.

"You're gonna need axle travel," Jer whispered.

"Give it to me."

He started tapping. My seat began to bounce under me. Speed built up. Jer cut in the rear axle feedback. "Give me more lights." He did.

Coming up this hill I'd zigged and zagged around small craters. At this speed, with this load, zigging was out of the question and if I hit one of those craters, D-4 and four people would be rolled up into one big mess. If I hit the brake, this was all for nothing. I raised the lights, focused the camera further out and let the seat of my pants pick a new path down full of gentle curves.

"Am I really saving any electricity?"

"You're on the plus side, Nikki," Dad answered. "Jer can run you the numbers when this is over. Trust your gut."

Dads can be wonderful.

I reached the bottom of the hill, feeling like I was five years old again and on my first skateboard. Rolling on and on, I "S" curved around rocks and craters as I slowed. I killed first one lamp, then another. Jer took the axle feedbacks off line. D-4 and I lumbered around several hillocks and began the long trudge up the next ridge.

"You've used thirty minutes," Dad said. "You've got one, maybe two, valleys to go."

It took forever to reach the crown of the next ridge. As I crested it, there was a beep in my ear. "Battery low," a computer voice told me.

"Kill that warning, and its readout from D-4."

Jer did.

We started to roll downhill. I limited myself to one light, and only the front-axle feedback. There was a thump, thump in the right tread, and D-4 was edging that way. Poor old girl was coming in lame. I gritted my teeth and steered for the valley, curving round rocks and craters as gently as I could. Not all of them, I bounced through a two-foot-across pothole, then managed to straddle a rock I didn't see until too late.

Steering got rough. Without my asking, Jer activated the rear axle system. Left side didn't come on. I swallowed hard, and kept going.

"Rescue Four is over the crest. Can you see her lights?" Rescue Center wanted to know.

"We're a tad busy at the moment," Dad answered for me. "Suggest they look for her lights."

"Rescue Four has D-4 in sight. Can you steer for them?"

"Which direction?" I got out through clenched teeth.

"Left, ten degrees," Jer said.

I turned left a bit.

"A bit more."

I did.

"That's good."

All I could see was a splash of light on a gray careening surface. I raised the headlamp, risking close in to avoid what was far out. I dodged a crater I hardly saw. A rock took D-4 full on the front, I hoped it missed Pink Suit.

I was at the bottom, losing speed. Losing it too quickly. Something was really wrong with D-4. I picked up a slash of light a bit off to my left and far ahead. I tried to aim toward it. D-4 did not want to respond. I gave her more of the joystick and got a bit of a turn. D-4 and I slowed to a crawl as another rig, bubble top showing human forms within came up to us. The last feeble rays from my headlamp died as my camera blacked out.

D-4 was stone-cold dead on the Moon. I was trembling in my room, Mom, Dad, Jer around me. I just sat at my control station, too spent to even get up. Jer offered me a hand, helped me to my bed. I collapsed. He sat down on my bed beside me.

And the alarm went off.

"I'll take care of that," Mom said.

Dad came over to kneel beside me. "You did very good, young woman. Very good. Both of you. Tomorrow, you'll have to tell me all about what happened."

"We will," Jer assured him.

The phone rang. "I expect I know who that is," Dad said and tapped the speaker phone. "This is Rocket Woman's Dad, and we may owe you an apology," he began.

"I'm the one who owes you more than a father can pay," was the caller's answer. "They have my daughter in the rescue rig. All four of them. Rescue Four now needs rescuing, I am told," he chuckled. "I believe my daughter would like to meet you daughter once she gets back here."

"I think that can be arranged." Dad said.

"Good. Until then?"

"Yes."

Jer and I went to school the next day, as much to see our friends as to get away from the cameras and ringing phones. For the same reason, or so we told ourselves, we cut out before our last class, taking a roundabout way for our walk home. Not so roundabout that I missed the Teddy Bear Factory.

We stared at the bears in the window. "I'm sorry, Nikki. They don't have the one you want," Jer said, real sadness tingeing his voice.

"Well, Mr. Jerrold Wolfgang Ebden, we will just have to have them make a teddy bear in a space suit."

"Riding a rover," he finished my usual want list.

"Nope. Riding a D-4 loader. Rocket Woman will not settle for less than exactly what she wants."

Jer opened the door for me, and together, we went in.■

Iron rusts from disuse; stagnant water loses its purity and in cold weather becomes frozen; even so does inaction sap the vigor of the mind.

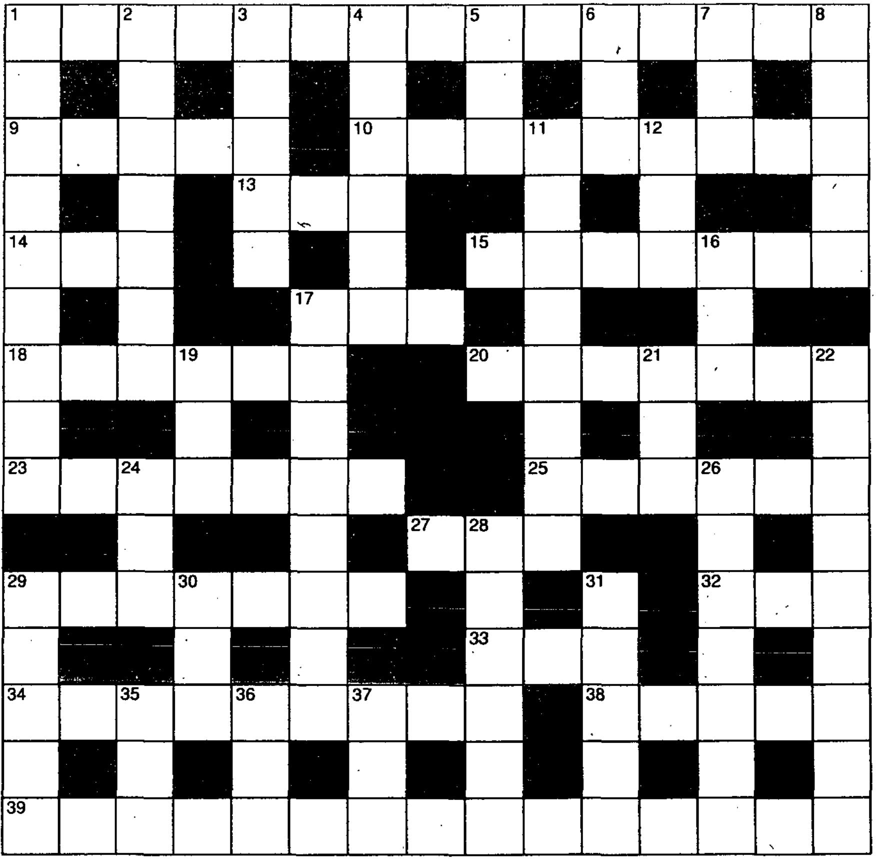
— Leonardo da Vinci

The greatest thing in this world is not so much where we stand, as in what direction we are moving.

— Oliver Wendell Holmes

CRYPTIC CROSSWORD

By James P. Hogan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answers on p. 144

Across

1 Proprietors hats restyled for Heinlein warrior. (8, 7)

9 Florida city featured in Bantam paperback. (5)

10 Dingy Siam construction causing disappointment. (9)

13 Regret French way. (3)

14 Manage sequence. (3)

15 Frosty, flaky fellow. (7)

17 Total doctor? (3)

18 In which this puzzle appears continuously changing. (6)

20 Wanderer among Jovian moons. (7)

23 Confused Santa reaches a hundred with devilish result. (7)

25 Shrub provided by sunless Caucasian. (6)

27 Sun formed from fifty sulfur and oxygen atoms. (3)

29 Beastly huge. (7)

32 Nasty matter of detailed cat. (3)

33 Beginning of time on course. (3)

34 The beloved of a Martian confused with love. (9)

38 Dallas returns with Noel. A mixed offering. (5)

39 A kind of charge by the Light Brigade? (15)

Down

1 Times with god endlessly, yet they happen every week. (9)
2 Pungent gas mania breaks out around Missouri. (7)
3 Sharp sting. (5)
4 So true reform denied. (6)
5 It's different! (3)
6 Loosely elliptical unfinished eggs. (3)
7 Character included in all biographies. (3)
8 Continue to tease headless beast. (3, 2)
11 Scotsman and Laura sound unidirectional. (8)
12 Go out of line back in Norway. (3)
16 In France, the word for catsup. (3)
17 Sparkling silver scatter. (8)
19 Poetic meadow in leafy setting. (3)
21 Republicans involved in piracy. (3)
22 Ecstatic arrangement of Pennsylvania orchids. (9)
24 33, 0, 1000. With upcoming 16, makes a drum. (3)
26 Cool tip changed the captain's right-hand man. (7)
28 Aquatic mammal heard Washington in Canada. (6)
29 I enter labyrinth to get Indian corn. (5)
30 Silent union head among thousands. (3)
31 To offend again has sticky consequence. (5)
35 Mimic agency turning upside down. (3)
36 Little month to rise about a hundred. (3)
37 Much of it was about nothing. (3)

Some Hints:

Rather than presenting simple definitions or questions of general knowledge, the cryptic style of crossword uses clues typically built around wordplays, metaphor, and double meanings. It appeals to those who enjoy the challenge of creatively working out a solution as opposed to either just knowing an answer or not, or having to guess at it.

A clue will frequently comprise of a definition of the answer along with directions for constructing it—very likely written in a misleading way to obscure which is which. Thus, the answer to “Satellite condition for descent on the house” turns out to be “Freefall”—the condition of an orbiting satellite—constructed from “on the house,” meaning “free,” and “descent,” i.e. “fall.”

Always look for possible meanings of words other than the apparently obvious. Thus, “Die of cold” could refer to an ice cube; “Tower of strength” to a horse towing a barge; “flower” might be a river—something that flows—and not a plant. Words like “confused,” “rearranged,” “could be” occurring in clues are often hints to the existence of an anagram. When considering anagrams, be aware that “one” may indicate the letter L while “quarter,” “point,” or “direction” may indicate the compass points, N, E, S, or W. Likewise, “note” could mean any of the musical notes: A, B, C, D, E, F, or G. The answer to “Sailor becomes famous with direction” thus turns out to be “Star”: S plus “tar,” a sailor. Or again, “Note agate mixed in the drink” gives the solver instructions to “mix”—form an anagram from—“note” (in this case B) and the letters of “agate” to give something found in a drink: “Tea bag.” Roman numerals, C, D, L, M, X are often used similarly.

Words like “back” or “returns” can indicate a word or letter sequence written backward. For example “Drab” as the answer to “Minstrel returns, dull and colorless” (“bard” written backward). Similarly, “up” can indicate a word or letter sequence reversed in a Down clue. Phrases like “seen in,” “found in,” or “held by” can indicate the solution to be literally in the clue; thus, “Stance,” the answer to “Position embraced by earliest ancestors” was there all the time in earlieST ANCEstors.

There are no rigid rules. The idea is to exercise ingenuity and have fun. A name frequently implies a diminutive form, such as “Ed” or “Ted” for Edward. “Said” or “sounds like” usually indicates homophones, such as “rain dear” and “reindeer.” “Head,” “tail,” “beginning,” “end,” and so forth can refer to the first or last letters of a word, e.g. “Rarity” as the answer to “Odd parity has new beginning.” Occasionally, a construction has no other merit than to inflict on the solver some exceptionally warped interpretation of a meaning that the compiler was unable to resist.

Figures in parentheses after a clue give the letter count of the words making up the answer. Thus (3, 2, 6) would indicate a three-word solution of 3, 2, and 6 letters.

Even if you could change your past,
it might be a shaky proposition. . . .

Built Upon the Sands of Time

Michael F. Flynn

A wise man once said that we can never step in the same river twice. A very wise man, indeed; because by that he did not mean we should refrain from bathing, as some half-wits at the Irish Pub have suggested, but that times change and the same circumstances are never fully repeated. You are not the same person you were yesterday; nor am I.

But perhaps that old Greek was not half so wise as he thought. Perhaps you cannot step into the same river even once; and you may not be the same person yesterday as you were yesterday.

Friday nights at the Irish Pub are busier than a husband whose wife has come home early. When The O Neil and myself arrived, the neighborhood crowd was there bending elbows with the University folks from down the street and making, as they like to say, a joyful noise. It was so busy, in fact, that Hennesey, O Daugherty's partner, had joined him behind the bar and even so they were barely keeping ahead of the orders. There were another dozen or so boyos in the back room, watching the progress of the pool table and providing encouragement or not to the players, as the case might be. The O Neil placed his challenge by laying a quarter down on the rail and promised to call me in for a game as soon as he won the table. Then he set himself to study the opposition. Seeing as how the quarters were lined up on the rail like so many communion children, I knew it would be a long, sad time before I held a cue in my hand, so I took myself back out to the bar.

O Daugherty Himself was a wise man, for he had saved a stool for my sitting and, more quickly than I could order it, had placed a pint of Guinness before me. O Daugherty is a man who knows his manners; and his customers, as well. After a polite nod to the man on my right, whom I did not know, I occupied myself with the foamy stout.

Hennesey was a contrast to his partner. Where O Daugherty was short, dark, and barrel-chested, Hennesey was tall, fair, and dour, one of the "red-haired race" from the North of Ireland. His long, thick, drooping face seemed always on the verge of tears, though never quite crossing over into the real thing. His shoulders were stooped because, tall as he was, he had to bend over to communicate with the common ruck. He gave me a smile, which for him consisted of raising the corners of his mouth from the vicinity of his chin to a nearly horizontal position. I hoisted my own mug in reply.

But no sooner had I taken the first, bitter sip than I heard Doc Mooney, on the far side of the oval bar, complain. In itself, this was no unusual thing, since complaint is the blood and spit of the man. But the nature of his complaint was more than a little out of the ordinary.

"Which of ye spalpeens," he cried, "has taken my jawbone?"

Danny Mulloney, sitting two stools to his left, looked at him. "Why, no one, you omadhaun, seeing as how you're still flapping it."

Doc gave him the squint-eye. "It's not my own jawbone I'm speaking of, ye lout; as you would know if you applied what little thought you have to it; but the jawbone we keep at the medical school for purposes of demonstration. I had put it in my pocket when I left for the day."

"Ah," said Danny with a sad shake of his head, "and I would hate to be your wife, then, after turning out your pockets for the laundering. Sure, a pathologist should never take his work home with him."

There was a ripple of laughter at our end of the bar. I confess that I smiled, myself, though it is my constant purpose never to encourage the wit of Danny Mulloney.

Doc turned a shade darker and tapped the bar top with a stiff finger. "I had set it right there, and now it is gone. Someone has taken it."

"You weren't thinking of leaving it as a tip, Doc?" I asked, getting into the spirit of he thing.

Doc gave me a look of betrayal. *Et tu, Mickey?* But Himself spoke up, a twinkle in his eye. "It would depend, I'm thinking, on how many teeth were yet in the jaw. Placed under my pillow, it might draw a tidy sum from the wee folk."

Hennesey only shook his head at the blathering of mortals. "Now, who would wish to steal such a thing?" he asked, *contrabasso*.

"Samson," Danny suggested, "were there any Philistines about." Danny being of a religious frame of mind, a Biblical example came most naturally to him.

Doc, who knows a little of Scripture himself, leaned past the poor man who sat between him and Danny and consequently had to listen to the argument with both his ears, and said sweetly, "Nor is it your own jawbone we're speaking of."

"There is too much foam," said the man sitting between them.

Both Danny and Doc pulled away, puzzled at the nonce of the sequitur. Himself eared up. "Too much foam, d'you say? Why, I give honest measure; and the man who says I do not is a liar."

The man blinked several times. "What? Oh." He glanced at the sturdy glass mug before him. "Oh, no, I did not mean your fine beer. I was responding to this gentleman's question concerning his jawbone. I meant the quantum foam."

Hennesey scratched his jaw. "The quantum foam, is it? And that would be an Australian beer?"

"No. I mean the timelessness that came 'before' the Big Bang. We call it the quantum foam."

O Daugherty drew a fresh mug and set it down with a flourish before the man. Sure and it is worth the price of a good pint to hear what connection there might e between the Big Bang and Doc Mooney's jawbone."

Doc protested again, "It's not *my* jawbone," but no one paid him any heed.

"Well," said the man, "not to the jawbone, but to the *disappearance* of the jawbone." He seemed hesitant and a little sad. For a moment, he managed to make even Hennesey look cheerful. Then he sighed and picked up the mug. "It's like this," he said.

"My name is Owen fitzHugh. I am a physicist at the University, but my hobby has always been the oddities of the Universe. Quirks, as well as quarks, as a colleague of mine has remarked . . .

"One of these quirks is what I call 'phantom recollections' and 'causeless objects.' Non-Thomistic events, if you must have a fine philosophical name for it. Have you ever looked in vain, as your friend here, for an object you clearly recall having placed in a certain spot? Or, conversely, found small objects for which you cannot account? Or recalled telephone numbers or appointments that turned out not to exist?"

"I had a key on my key chain, once" said Maura Lafferty, "that I did not recognize and that fit no lock that I own. I still have no idea where it came from."

"I had a date one time with Bridey Lynch," said Danny, "but when I called on her, she had no recollection of it."

Doc made an evil grin. "Why, there is no mystery at all in that."

FitzHugh nodded. "They are usually small objects or bits of information, these anomalies of mine. Usually, when we notice them at all, we ascribe them to a faulty recollection; but I'm a natural contrarian. I wondered: What if it is the Universe, and not ourselves, that sometimes forgets."

Danny and Doc flanked the poor man with a bookend of skeptical looks. Danny, I was sure, believed in God's Infallible Memory; while Doc reasoned from the predictability of Natural Law. Still their thoughts had come to rest in the same place. Himself shifted his apron and cocked his head in interest. "Now what might that mean?"

"History is contingent," said fitzHugh.

Himself nodded. "Aye, so it is." But Danny scratched his head. "If it is, I've never caught it." Doc leaned past the unfortunate physicist once more.

"He said 'contingent,' not 'contagious.'"

FitzHugh looked at Danny. "I should have said that history is a chain of cause-and-effect," he said. "One event leads to others, and then to still others. Often, great events hinge on small occurrences."

Wilson Cartwright, a history professor at the University, spoke up from the booth behind fitzHugh. "That's gospel truth. In 1862, a Confederate courier lost a copy of Lee's troop dispositions. Two Union foragers found them and McClellan managed—barely—to win the battle of Antietam, which gave Lincoln the opportunity to issue the Emancipation Proclamation. And when the news of the Proclamation reached England, the cabinet reversed its decision to intervene on the Confederate side. In consequence of which . . ." He lifted his drink in salute to the bar. ". . . my great-grandpappy became a free man."

Hennesey nodded. "Da met me Ma in the same way. Another small chance—though the outcome was not so momentous as war and freedom. He was on the run—. This was during the Troubles, when the Big Fella and the Long Fella had their row—bad cess to 'em both—and Da, he found himself in on the wrong side. O Daugherty, you know what I'm speakin' of, and enough has been said about that. Da took himself to the Waterford hills and, finding himself at a crossroads, tossed a coin The shilling sent him to Ballinahinch, where me ol' Gran was keeping a pub in those days and Ma waited tables. Now Da was not the man to pass a pub without a drop of the creature, so he stopped and . . ." The man's long, doughy face turned a deep red. ". . . here I am. Had the shilling read tails, he was a dead man, for his enemies were waiting down the other road. As it was, what with one thing and another . . ." And he pointed with his drooping chin to the photograph on the wall opposite, where a far younger Hennesey and O Daugherty stood side by side in black-and-white, stern-faced splendor, arms crossed and legs akimbo before the newly-opened Irish Pub.

Doc Mooney raised his pint. "I have always thought you an unlikely man, Hennesey."

"But that's just the point," fitzHugh said. "*Everything* is unlikely . . . and therefore fragile."

"'Fragile,'" said Himself. "A curious word."

"Fragile," said fitzHugh with an affirmative nod. "Because the slightest bump and. . . . You see, the quantum foam is subject to sudden, spontaneous disturbances. These create 'probability waves' in the continuum that propagate down the time stream creating a new past. The old past is obliterated. As it was in the beginning, is not, and never more shall be."

Himself scowled a bit at the altered quotation, but Danny Mulloney brightened, which is always a bad sign. "Do you mean to say," he said. "Do you mean to say that all those dinosaur fossils and such might have been put in the ground only a few thousand years ago?"

FitzHugh blinked and looked thoughtful. "Certainly, it's *conceivable*," he said slowly. "Yes. Suppose that evolution originally followed a different course—perhaps those strange Burgess Shale creatures I've read of won out over our own familiar phyla, and after a time strange *things* stalked the Earth of sixty million years ago—things that never held the promise of man. Then, a bubble bursts in the foam and a probability wave ripples down the timeline—and now dinosaurs leave their bones in the mud instead of things with no names. So, yes, in one sense, this new past could have been laid down a few thousand years ago; but in another sense, once it had been laid down, it had *always* been there."

Danny pursed his lips, for I do not think he had envisioned a *different* evolution when he raised his question. Meanwhile, a ripple of wisely-nodding heads showed the incomprehension propagating around the oval bar. FitzHugh noticed and said, "Perhaps a sketch will clear it up." He seized a napkin and immediately began to doodle on it. Sitting as I was on the far side, I could not see what he sketched and Hennesey, noting my frustration, waved me inside the Sacred Oval. "Here," he said, handing me a bar apron, "'Tis a busy night and we can use the help." Then he set off o the front end of the bar to tend to the raging thirst there.

Tying the apron, I stepped across in time to hear fitzHugh say, "This was the continuum in its original state." I glanced at the napkin and saw he had written:

A→ B→ C

"Then, a quantum disturbance alters event A to event A^*. A stray chronon—a quantum of time—emitted from the foam, strikes like a billiard ball." He turned to Dr. Cartwright, who had left his booth to stand behind him. "Perhaps your Confederate courier, Wilson, doesn't drop his packet." He held up the napkin again.

A^* , B→ C→ D

The big historian looked thoughtful, and nodded. Maura Lafferty, who had also joined the little group at the back end of the bar, leaned over the man's shoulder. "Why did you add the 'D'?"

"Oh, time doesn't stop just because there is a bit of redecorating going on," fitzHugh said. "The present is . . . call it the 'bow wave' of the Big Bang, plowing through *formlessness* and leaving *time* in its wake. But behind it is coming the 'bow wave' of the *new* version, altering all the original consequences of A. When the wave front reaches B, event B 'unhappens.' Something else—call it G—happens instead."

$$A^{*\rightarrow}\quad \cancel{B}^{G}\quad C\rightarrow\quad D\rightarrow\quad E$$

"Why G?" Danny asked, frowning over the sketch. "Why not call it B*?"

"It doesn't matter what he calls it, ye spalpeen," said Doc Mooney.

FitzHugh grimaced. "Actually, it does. I don't want to imply that B happens *differently*—because it might not happen at all."

Cartwright bobbed his head. "That's right. If McClellan hadn't intercepted Lee's orders, it wouldn't have changed the outcome of Antietam. There wouldn't have *been* a battle at Antietam. McClellan only attacked there because he had Lee's orders. Without them, there would have been a different battle at some other time and place."

I scratched my head. "So why didn't you alter C, D and E?"

"Because the wave front hasn't 'caught up' to them yet." He busied himself at the napkin. "Here, this is then next quantum of time, the next parasecond."

$$A^{*\rightarrow}\quad \cancel{B}^{G\rightarrow}\quad \cancel{C}^{H\rightarrow}\quad \cancel{D}^{I}\quad E\rightarrow\quad F$$

"You'll notice that the original causal chain is still propagating itself, and event E has led to event F. But the revision is catching up. Change waves move faster than one second per second—just as water moves faster down a channel already dug than it does across virgin ground—but you really need two different kinds of time to talk about it intelligently. Eventually, the change wave reaches the present, merges into the original Big Bang wave, and the revision is complete." He held the napkin up one last time.

$$A^{*\rightarrow}\quad \cancel{B}^{G\rightarrow}\quad \cancel{C}^{H\rightarrow}\quad \cancel{D}^{I\rightarrow}\quad \cancel{E}^{J\rightarrow}\quad \cancel{F}^{K\rightarrow}\quad L$$

"Even our memories are reconfigured," he said. "The right ripple and . . . who knows? We might be sitting here discussing Lee's victory."

"*You* might be," said Cartwright dryly.

Doc Mooney rubbed his chin and frowned. "I see a problem," he said. He spoke with a chuckle, as if he suspected his leg of being pulled. "If our memories are reconfigured, how could we possibly know the past was ever different?"

The shadow passed over fitzHugh's face once more. "Normally . . . we wouldn't."

Doc Mooney slapped his forehead. "Now, I am an old fool. I had *started* to put the jawbone into my jacket pocket, then I laid it back on my desk." Defiance flashed "And it has been sitting back there in the lab, all along" he insisted.

FitzHugh nodded with solemn fish-eyes. "Yes. Though perhaps not 'all along.' If a the very moment you laid the jawbone on the bar, a change wave 'caught up' with the present, you would have for a bare instant two conflicting memories. A fragment of the original memory can survive and you sit here at 'L' remembering a bit o 'F,' instead of 'K.' The French have a word for it . . ." He snapped his fingers, searching for the word.

"*Merde?*" suggested Doc innocently.

"*Déjà vu?*" said Maura.

FitzHugh shook his head. "No. *Déjà vu* is when the change wave does not affec your own personal history, so instead of a fossil memory, you have an instant of re membering the same thing twice." He looked at each of us, and it seemed to me that his eyes held immeasurable loneliness in them. "That's why these phantom memories almost always involve trivia." He shrugged, looked off at the corner. "Only an idle fancy. Who can say?"

Himself lifted fitzHugh's now-empty mug and cradled it in his hands. He gave the physicist an intent look. "*Almost* always," he said, with a suggestive pause at the end.

FitzHugh shook his head and gestured at the mug. "Another, please."

"Perhaps," said Himself, "it would be better if you let it pour out instead of in."

("What's he mean?" Danny asked. "Wisht," said Doc.)

Someone put "The Reconciliation Reel" on the juke box and fitzHugh winced as the wild skirling of whistles and fiddles filled the room. Some of the old neighborhood shouted Hoo! and began to clap their hands. "You'll think I'm a fool. Deluded."

Himself shrugged. "Does it matter if we do?"

"Sure," said Doc Mooney, "we all think that Danny here is a deluded fool; but that doesn't stop me from buying him a beer now and then."

Danny, who could be quick on the uptake when the stakes were high, held his mug out to me and said, "You heard him."

Sure, it is not often that Doc is hoist by his own petard, but he had the good grace to accept it cheerfully. While I filled Danny's mug, fitzHugh looked on some inner place in his soul.

"You see," fitzHugh said finally, "the brain stores memories both holographically and associatively. Because the memory is a hologram, one may recapture the entirely from a surviving fragment; and because they are 'filed' associatively, one recovered memory may lead to others. These shards of overwritten memories lie embedded in our minds like junk genes in our DNA, an explanation perhaps for stories of past lives'; for false memory syndrome; or for inexplicable fugues or personality changes or . . . Or. . . ." He paused again and shuddered. "Ah, God, what have I done?"

"Something," O Daugherty suggested, "that needs a hearing."

"From the likes of you?"

Himself took no offense. "From the likes of us," he agreed, "or the likes of Father McDevitt."

FitzHugh bowed his head. There had been fear in his eye, and sorrow, and depair. I wondered what odd confession we were about to hear, and ourselves with no power to bind or loose. Maura placed a hand on his arm. "Go on," she urged. Cartwright rumbled something encouraging and Danny had God's grace to keep his mouth shut.

Finally, fitzHugh drew a shuddering breath and blew it out through pursed lips. A man cannot be responsible for something that never happened, can he?"

Himself shrugged. "Responsibility is a rare thing in any case: a bastard child, often denied."

"It started with a dream," fitzHugh said.

"Such things often do. And end there, too."

"I'm not married," fitzHugh said. "I never have been. There have been women rom time to time, and we get along well enough; but there was never one to settle own with. Always it was too early to wed; until it became too late."

"It's never too late," O Daugherty said, "when the right one comes along."

FitzHugh's smile was faint. "That's the very problem, you see. It may be that she id, once. But . . ." Melancholy closed his face again and he inhaled a long, slow reath. "I live alone in a house in the middle of the block over by Thirteenth Street.

It's a little large for my needs and the neighborhood is not the best, but the price was right and I enjoy the puttering. There is a parlor, a dining room and kitchen, plus two bedrooms, one of which I use as an office. From the kitchen, a stairway leads to a rough, unfinished basement.

"Recently, I began to have a recurring dream. It always starts the same way. I walk through my kitchen to the back stairwell and go down, not to my own basement, but to another house entirely, where I walk past empty bedrooms, then a kitchen with dishes piled in the sink and a greasy patina to the stove, coming at last to a parlor containing comfortable, out-of-style furniture. There are large windows on two of the walls and, in the corner, a front door. The whole of it has such an air of dust and neglect and familiarity and long abandonment that I often find myself reduced inexplicably to tears when I awake."

"It was your subconscious," said Doc, "playing with that unfinished basement."

FitzHugh gave a brief shake of the head. "I thought that, too; at first. Only . . . Well, the first few dreams, that was all. Just a silent walk through an empty house accompanied by a feeling of loss, as if I had had these disused rooms all along, but had forgotten about them. Once, I reached the front door before waking up, and stepped outside. An ordinary-looking neighborhood, but no place I've ever seen. The house sat on a slight rise on a corner lot. Not much traffic. If I had to guess, I would say a residential neighborhood in a medium-big city, but somewhere off the major thoroughfares. I travel a great deal, going to conferences and such, but I have never identified that city."

He looked deeply into his ale while the rest of us waited. "The dream had a curious air to it. It felt like a memory more than a dream. Maybe it was the dirty dishes in the sink, or the out-of-date furniture in the parlor." Another quirky smile. "If a dreamworld, why so drab and ordinary a one?"

I left the group to answer an urgent call at the front end of the bar, where a shortage of brew threatened several collegians with imminent dehydration. When I returned to the discussion, fitzHugh was answering some question of Doc Mooney's.

". . . so the more I thought about it and puzzled over it, the more real it grew in my mind. I remembered things I never actually saw in the dream. It seemed to me that the sink ought to have separate hot and cold water faucets. And that upstairs there would be an office and a sewing room and another bedroom. So you see, the details had the *texture* of memory. How could I remember those things unless they were real?"

Doc pulled the squint-eye like he always does. I think he still suspected some elaborate joke at his expense. "Imagination can be as detailed as memory. Your dream left blanks and you began to fill them in."

FitzHugh nodded. "That's an answer I yearn for. If only I could embrace it."

"What happened next?" Himself prompted. "There must be more to it than you've told to account for such a melancholy."

The physicist drew a deep breath. "One evening, reading at home, I became acutely aware of the silence. Now I am a man that likes his solitude and his peace and quiet; but just for a moment the silence seemed *wrong*, and I wondered, *What's he up to?*"

"Who?" asked Danny. "What was *who* up to?"

FitzHugh shook his head. "I didn't know, then. But I glanced at the ceiling as I wondered, even though there is nothing up there but a crawlspace and storage. And then I heard a woman's voice."

"A woman, was it?" said Himself. "And saying what?"

"I don't know. I couldn't make out the words, only the tone of voice. I knew tha had been addressed, and inexplicably my heart both soared and sank. I can't exlain it any other way. It was as if I had been yearning for that voice and dreading it, ll at once.

"Well," he continued, "associative memory means that one recovered memory an lead to others; and having found a fragment of one hologram, other fragments egan to surface in my mind. I had only to close my eyes and imagine the phantom ouse. With each return, it became more real, and the conviction grew that I *had* ved there at one time, and not alone. Voices—there were two of them—grew more istinct. Often angry, but not always. Once, I'm embarrassed to say, whispering a exual invitation. And then, one day, I saw her."

He lifted his mug to his lips, but it hovered there without him drinking as he azed into the dark, reflective surface. "I was puttering in the parlor, sanding down ome woodwork in order to stain it. It was the sort of mechanical task that allows e mind to wander. And so mine did, until it seemed to me that I was in the kitchen f my 'secret house,' drying dishes with a towel. A tall, straw-haired woman was anding beside me washing them in the sink. She had the nagging near-familiarity of once-met stranger. Perhaps I had seen her at a party in college and I never got up e nerve to walk over and introduce myself—only maybe, once, I did. I knew she as angry because she would *shove* the dishes into my hands in that silent-aggresve way that women sometimes use. She bore the harried look of someone once ery beautiful but for whom beauty had lately become a chore. No makeup. Hair opped in the simplest, most 'practical' style. Perhaps she blamed the me-that-was. ter, I remembered cutting remarks. She could have been this, or she could have arried that. I don't know why she kept slipping such hurts into our conversation ." He smiled ruefully. "But this first time, she turned to me and said very distinct, 'You have no ambition.'

"I was so startled that I snapped out of my daydream, and there I was, back in my vn parlor." He grimaced, ran a finger up and down the condensate on the outside his glass. "Alone."

"It's only natural," said Doc Mooney, "that a man living alone might grow wistful d imagine a married life he never had."

FitzHugh laughed without humor. "Then why imagine such an unpleasant one?"

"Because you need to feel that you made the right choice."

"You're a psychiatrist, then, and not a pathologist?" The tones were sarcastic and oc flushed red. FitzHugh fell into a brown study, and fixed his eyes on the far wall. e rest of us, supposing the story had come to an unsatisfying conclusion, went out our own affairs: O Daugherty and myself to filling glasses and the others to nptying them, which division of labor made for an efficient process. Once or ice, I glanced at fitzHugh, noted his unfocused eyes, and wondered on what inner ndscape he gazed. There were tears in the rims of his eyes. When he lifted his glass me and signalled, I gave Himself a look and he gave me the high sign, so I itched fitzHugh's drink to a non-alcoholic beer. I don't think the man ever noed.

"I had a son," he told me when I handed him the freshened glass. No one spoke. c, from wounded pride; Danny, because of a firm headshake I gave him.

"A son, was it?" said Himself. "Sure, that's a comfort to a man."

FitzHugh made a face. "Lenny was anything but a comfort. Sullen, secretive. Selm home, even for meals. Lisa blamed me for that, too."

"He was a teenager, then."

FitzHugh started and a rueful smile curled his lips. "Yes. He was. Is that normal bevior for that age? For the sake of other parents, I hope not. I've remembered flashes of him mouthing off, and once or twice I've even heard echoes of the foul words he used. I've another memory of a policeman standing in the front door holding Lenny by the arm and lecturing me." He sighed. "Sometimes I wished we had never met, Lisa and I; and that I had married someone else and had different children; that well . . . that everything had turned out better than it had."

"Then it was good fortune," I said, "that some bubble in the foam erased it."

FitzHugh was a big man; not muscular exactly, but not frail-looking, either. Yet, he gave me a desolate look and laid his head on his arms and began to weep. O Daugherty and myself traded glances and Wilson Cartwright said, "I know where he lives I'll drive him home." FitzHugh raised his head.

"Sometimes, I remember other things. Huddled over a kitchen table with Lisa planning a future full of hope. A young boy bursting with laughter showing me a horse he had modeled out of clay. A camping trip in the Appalachians. Holding hands in a movie theater. Fleeting moments of simple pleasures. The joy had al leaked out, but once upon a time . . . Once upon a time, there had been joy."

A wretched tale, for who among us has not known friend or family in a like situation? Sure, the wine may turn to vinegar in the bottle. And yet, who can forget how sweet it once tasted?

Himself nodded as he wiped a glass clean. "Are you ready to tell us now?"

FitzHugh grunted, as if struck. He eyes darted about our little group and found me. "It was no chance bubble," he said, shaking his head sadly.

That startled me. "Then, what—?"

"I don't know what sort of research my dream-self was doing. I recall enough tantalizing bits to realize it was down a different avenue than I've explored. But I do remember one especially vivid dream. I had built a chronon projector."

Doc Mooney snorted, but Himself only nodded, as if he had expected it. Maur Lafferty wrinkled up her forehead and asked, "What's a chronon projector?"

Frustration laced the physicist's voice. "I'm not sure. A device to excite time quanta, I think. Into the past, of course. There's nothing but formlessness futureward o the bow wave. Perhaps I had some notion of sending messages to warn of tornado or disasters. I don't know. The projector was only a prototype, capable only of emitting a single chronon to a single locus. Enough to create a ripple in the pond; no enough to encode a message." He upended his mug and drained it and set it dow hard on the bar top. "Call it a 'cue stick,' if you wish. Something to send a billiar ball into the packed chronons of yesterday and start random ricochets of cause an effect.

"Yesterday, I had no classes to teach, so I stayed home to paint my dining room. was thinking about mutable time; and I had my hand raised, so." And he held h right hand just before his face. "There must have been some congruence of my trai of thought and my posture, because in that instant I was standing in a lab befor some great machine and my hand was gripping a switch, and I remember . . . Lis and I had had an argument over Lenny, and I remember . . . I remember thinking th if I projected the chronon to the locus when Lisa and I met—to that time an place—I could create a ripple in the Dirac Sea, a disturbance in the probabilities an . . . It would all never have happened. None of it. The heartache, the bitching, th sullen anger—" He fell silent.

Himself prompted him. "And . . . ?"

"And I awoke in a strange house, silent and alone." He looked a long way off, seeing what, I do not know. Himself laid a hand on his arm.

"Wisht. What you had, you lost well before you threw the switch."

FitzHugh grabbed O Daugherty's hand and held it tight. "But, don't you see? I lo ll the hope, too. The memories of all the joy that went before; of a bright-eyed five-ear-old whose smile could light the room. Of the possibility that Lisa and I might ave worked it through." He and O Daugherty exchanged a long, mutual look. "I wed her that, didn't I? I owed it to her to try to solve our problems and not abolish hem as things that never were."

"Sure," said Himself, "the bad comes mingled with the good; and if you excise the irst, you lose the other as well."

"There's one thing I hold on to," fitzHugh said.

"And what's that?"

"That Lisa—whoever she is, from whichever college mixer or classroom where ve never met—that in this revision, she's had a better life than the one I gave her. I old that hope tight as a shield against my crime."

"Crime?" said Danny. "What crime was that?"

FitzHugh wiped his eyes with the sleeve of his jacket. "Lenny. He was never born. e'll never have a chance to grow out of his rebellion and become a better person. isa is out there somewhere. Lisa has . . . possibilities. But there is no Lenny. There ever was that bright-eyed five-year-old. There never will be. When I disturbed the me-stream, I wiped him out. I obliterated his life: all the hopes and fears and hates nd joys . . . All the *possibilities* that were him. How is that so different from murer?"

The silence grew long.

Then fitzHugh pushed himself away from the bar and stood a little uneasily. larmed, Professor Cartwright took him by the elbow to steady him. FitzHugh oked at the rest of us. "But it all never happened, right? There oughtn't be any guilt ver something than never happened."

It was Danny who spoke—hesitantly, and with more kindness than I had looked r. "Could you not build another of those chronon projectors and aim it back and orrect what you did. . . ?" But he trailed off at the end, as if he already suspected hat the answer must be.

FitzHugh turned haunted eyes on him. "No. History is contingent. There's no ance that a random disturbance to the revision would recreate the original. You ay break the pack on a pool table with a well aimed shot. You cannot bring the lls back together with another." Cartwright guided him to the door, and the rest of s watched in silence.

"The poor man," said Maura, when he had gone.

O Daugherty rapped hard on the maple counter top, as if testing its solidity. "So agile," he said, almost to himself. "Who knows if another time wave might be roarg down on us even now, a vast tsunami to wash all of us away?"

The O Neil returned from the back room with a glower on his face. "Ireland will t the Six Counties back before I get that pool table," he said. "Let's go on back to e house, Mickey."

"I'll catch you later," I told him. "It's a busy night and Himself can use the help as uch as I can use the cash."

The O Neil shook his head. "O Daugherty, you need to take on a partner, and at's a fact."

Himself shrugged and served him a parting glass of black Guinness. "Someday, aybe," he said. Me, I glanced over at the photograph on the wall, where O Daughty stood, arms crossed and legs akimbo, before his newly-opened pub; and it emed to me, though I don't know why, that the picture was all out of kilter, as if mething large were missing.■

Diplomacy is too important
to be left entirely to diplomats. . . .

The Hanoi Tree

Shane Tourtellotte

Illustration by Vincent Di Fate

People say I'm some kind of genius or hero, but I'm not. They say I should be proud. They can say that: They're not the ones who lost a friend.

I didn't even want to move to Nepalganj. It was the newest settlement on Terai then. Mom had helped plan it. If it was good enough for her, it was good enough for all of us, so we went.

We moved there days after I turned nineteen. Dad, of course, kept insisting I was nine and a half. He likes going by Earth time, years that are two years long, minus some hours. He keeps saying when I'm his age, I'll understand.

Winter was starting, and Nepalganj was deeper in the path of winter rains than any other town. Weather kept me inside almost all the time. My friends were all in Lalitpur. Mom and Dad tried to make me make new friends in town, but I kept netting with mine instead.

I got outside town to explore a couple times when the weather improved, and once during a storm just to get away. I walked around the paddies to the southwest, but how much can you look at people wading through water and mud before you want to go back inside?

I didn't go anywhere else until spring, when some days actually got sunny. I'd say I was going to visit classmates, usually just before second dawn. They believed me. Mom did, anyway. I think Dad knew better, and still let me go.

I looked around the south hills some, but they're mostly rocks and native carpet lichens. Maybe I was saving the best for last, the woods and West River. Maybe I was like everyone else, kind of afraid to get that close to their territory.

Back then, I wasn't thinking about them. I was looking for good climbing trees, finding springpups to chase, to watch them jump away. Sometimes I even found gliders' nests in the middle levels of the trees. I left them alone, except for looking. I was late getting home once from that. Big trouble.

I went far enough to see the Thruha town a couple of times, hiding and peeking through lacebushes. It was all full of round shapes, like I knew. I could see vehicles move, and sometimes them, really small, so you might think they were humans. It was like a dare game. I always ran away after a few minutes, imagining they might have seen me, might come to get me.

It got to midsummer, really hot, and I had explored the woods out. I might have quit going, except for that one day. I'd eaten dinner early, and it was still soon after sunrise when I got to the woods. I thought it was just shadows first: the Sun was behind him and everything. Then I got closer, and saw him looking back at me.

I learned all about the Thruhas in school, of course. I knew what they looked like. This one was around my size, taller but thinner. A kid, like me.

I just stood there. This was a dare game for real. I was thinking maybe he didn't recognize me, that he might go away. Then he started walking, kinda slow.

I thought, wow, maybe he's scared of me. Well, I wasn't gonna be more scared than him. Not in a dare game.

We got close, around a meter, then really started looking at each other. He seemed different from my lessons. His skin was lighter gray, and the fuzz on his head darker black. He had on clothes, a loose shirt and pants, not like the model on my class desktop. I couldn't see his weird elbows, or the navel halfway up his chest, or the place all the kids giggled at.

He was looking at my feet. I looked too. I had summer sandals on, so he could see my toes sticking right out. He just had little bumps on his bare feet, so I must have looked strange.

I wiggled them, and he made this little clucking noise inside his mouth. I guessed he was laughing, but back then I didn't know. I laughed too, a little. Maybe toes really are strange.

We stood there, looking, not saying

anything. Of course we couldn't talk to each other, but we had to do something. We couldn't just go home. I couldn't.

I pointed to a nearby tree, and started walking there. He followed slowly, his head tilted like he was trying to look at the tree better. "Come on," I said, "I bet I can climb higher than you."

He didn't get the words, but when I started shinnying up the trunk and reaching for the first level of branches, he figured it out. I watched from above. I thought his hard feet would make it tougher, but they anchored him really well. Squeezing through the branches was easier for him, and soon he was sitting on the first canopy with me.

He said something, obviously happy, but loud. "I can hear you," I said, holding my ears. His lips scrunched in, and he talked again, softer. "That's better. Okay, let's go for two."

I surprised him by climbing higher, but he followed. It was an old Tower of Hanoi tree, twelve levels, and I knew I could climb up at least eight. He stayed with me up four, then had trouble getting to the fifth. The distance between levels gets taller, and the bark is smoother, so his feet had fewer places to go. He finally got up, but looked at me on the sixth level and dipped his head, so the jaw touched his clavicle ridge.

I knew that was a 'no' gesture, but I waved for him to come up anyway. "You can make it," I said. He dipped again, and again, but I was starting to get to him.

Suddenly he looked south, at the sky. A Bruiser eclipse was starting; a slantwise shadow was already on the Sun. He sat himself on a big branch, back against the trunk, and held his fingertips together, two groups of three against three.

I said "Hey" once before deciding I should leave him alone. He began speaking softly to himself during totality, stopping when the Sun appeared again. It was a quick eclipse, a minute and a half, and when it was over he looked up at me again, like nothing had happened, and started trying to climb.

"No," I said. "I gotta go." I'd just remembered when that eclipse had been forecast to happen. He looked at me strangely as I climbed down past him, but he followed me.

I waited for him on the ground. "Can you come here again?" He said something, but I didn't know what it was. "Come here," I repeated, pointing all around the woods. "I'll be here again." I pointed to myself, at the ground, then at him.

He tipped his head, then jerked it upward. He pointed at both of us with one hand, like Thruhas can, made circles in the air with the other hand, then pointed down.

"Yeah," I said, hoping. "Gotta go now. Bye." I tried not to walk away too fast, even though I was late. I waved back at him once. He had his arms stretched out, which I figured might be like waving. I couldn't ask.

The second time I looked back, his head was disappearing beneath a rise in the ground. I hoped I hadn't gotten him in trouble with his parents, and started running.

I got home in time for supper, so nothing happened. The next day I finished homework right after school, so I knew I could go out again after dinner. Mom kept me in for chores, and I was lucky she didn't give me more for being so eager to get outside.

I went right back to the same tree in the woods, and waited. After half an hour I climbed the tree, nine levels, to see farther. I saw everything between me and the Thruha town, but I didn't see him. I waited almost until midday, even though I knew that was really late.

I hated to give up, but I had to. I raced home, looking up in the sky to spot the crescent Bruiser, even though it was cloudy that day. I kept thinking, if I get home before the eclipse starts, it won't be too late. I was late anyway, half an hour, with supper waiting. I hoped Dad got to me first.

Mom was waiting at the door. I slowed to a walk—a march, I told myself, facing my doom bravely. I knew it was better than whining and pleading.

"Kevan," she started, "why do we buy you a watch, if you still make yourself late? Supper's been ready for almost an hour. Your father's already eaten, so he wouldn't be late for the Translation Committee meeting. What do you have to say for yourself?"

I looked right at her, with her angry eyes, and her brown hair bunched tightly behind her neck. It hurt, but less than not looking at her would later. "I was wrong, Mother." That was my best answer with her, and she hadn't figured out I knew that yet.

"Yes. You were. You're not to play outside after school again, until I say otherwise."

"I understand, Mother." I could safely drop my eyes now.

"Right." The storm began receding. "Now go inside and heat up your supper, and then get to bed."

She waved me inside, and sat across from me while we ate. I didn't mind going to bed early after that. Besides, I wanted to get up extra early.

The next day was Early Saturday. I got up around half past five, much earlier than my parents on the weekend. I hurried through breakfast, and almost had my dishes clean before I heard footsteps on the stairs. I could tell it was Dad, so I might have a chance.

"Hey, Kevan. Why are you up so soon? And dressed?"

Dad was in his pajamas, and I already had outside clothes on. "I wanted to go somewhere, only . . ." He'd definitely find out some time. I spoke even softer. "Do you know Mom's punishing me?"

"Yes. No playing outside nights after school. I think that's proper. You really should get in earlier."

"Does that mean I can't go outside today?"

Dad smiled. "It's not night. It's not after school. Will you be gone past lunch?"

"No. Maybe."

"Want to make some lunch to take with you?"

I started smiling, too. "Yeah, I better."

He helped me put some food slices and a bottle in a sack, carefully, so Mom wouldn't wake up. "Where is it you've been going, Kev?"

"The woods, southeast of here. Lotsa good climbing trees."

"I'll bet. Are you going with friends?" He got more serious. "Anyone I should know about?"

"Well . . . I'll tell you about him sometime. When I know him better."

"Okay." He rumpled my hair, and I pretended to hate it. "Get going, quietly. I'll make it all right with your mother."

"Thanks," I whispered, and snuck out the door. I worried that Dad might be the one in trouble now, but I didn't worry for long.

He was waiting for me. "Where were you yesterday?" I asked, but he couldn't understand. He said something back to me, and probably thought I was pretty stupid too. He did know what my pointing at the tree meant, though.

I went up six levels again, easily, and waited for him. He got up five fine, and tried hard to reach me. He had one arm through the canopy, bending every which way to grab something sturdy. He got a branch, but it snapped.

I reached fast, but he was already falling. He hit the fifth canopy, grabbed on wherever he could, and scrambled to the trunk. He held on for a second, then started climbing down fast. I went after him.

He was kneeling on the ground when I reached him. "Are you okay? Are you hurt?" He had leaf stains on his clothes, and a tear near the wrist. "Let me see."

I looked under the sleeve. His skin had dark red scratches, but no cuts. I sighed gratefully. "I'm sorry. Really I am."

His closed mouth stretched back into his cheeks. He stood up, my hand still holding his scraped wrist. Then his golden irises grew, shrinking the black in his eyes.

I kinda saw the covering pulling back on his palm, but I didn't know what he was doing until he grabbed my hand. It wasn't painful, but it was terribly uncomfortable. My whole body got tense, and my arm itched. I had to pull away.

He looked really sorry for what he did. "Don't worry," I had to tell him, putting my arms on his shoulders. "I'm fine now, but . . . humans don't communicate that way. See?"

I showed him my palm, without the calluses in the center, and shook my head. He ticked his head up a few times, then walked away. I thought he was leaving, but he came back in a moment.

He pointed at the ground between us, then at a tree maybe a hundred meters away, then back to our ground. He said three short words, then a louder one. I shook my head.

He did it again, but this time held up his hand during the words. His fingers were together, three on three, then two sets were, then one, then—

"Go!" I nodded, confusing him, then nodded up his way. He said something, then started counting.

"*Nuth, hiff, roos, TA!*"

I tried, but he kept getting farther ahead. He had trouble turning at the tree, and I got close again there, but he beat me back easily. He said something while I was huffing and puffing, something with *roos* at the end.

"Another one? Not right now. Let's just lie down."

He went down next to me, then sat back up right away. He made that fingers-together sign again. It would only be a partial eclipse: something about orbital inclination. I watched the Sun and the green-blue sky with him. I wanted to ask if he did the same thing when Doozer eclipsed. That one's always partial.

He finished in a minute, then pointed toward his town. "No. So soon?" He pointed down, made circles in the air, and tipped his head. I nodded up. Sure I'd come back.

It began raining on Late Saturday, before I went to bed. It kept raining all Early Sunday, stopping past midnight. I never thought of going out. Not even Dad would have let me.

I would have thought I missed him, but I had another idea. I finished my homework before lunch, and offered Mom to do chores. She had me do plenty, straightening the living room, the bathroom, my diskshelves, making them perfect, the way she liked. I finished right before dinner, looking happy for her.

"I suppose you'll want to go out after we've eaten," she said. At least now I didn't have to ask. "Help me clean up in the kitchen, and you may, but no more than two hours."

I took the deal, and even got a kiss and a pat going out the door. I ran out of town, kicking up sprays from the feathermoss still moist from rain.

I hoped I was right. He swung his hand in the air three times. It was three days between our first two meetings. Humans cycled during two Teraidays, but maybe not Thruhas.

Nobody was there under our tree. I started moaning, but something bounced off my ear. I looked up, and there he was, four levels high, dropping pebbles at me.

I went after him. This time he made it up six, but I still caught him. There wasn't much I could do to him, though. We stayed up there a while, taking turns seeing how far we could throw pebbles into springpups' fur, then watching them shake them out.

I plucked one thin green leaf and started chewing on its end. He grabbed my arm frantically. "It's okay," I told him. I knew they were harmless for humans, and now I supposed they weren't for him.

We finally exchanged names. I figured

out his before he understood mine. We had a pretty good time until I had to go home. I still couldn't beat him in a race, though.

"Who have you been going to meet, Kevan?" Mom asked at supper.

I almost griped at Dad for telling, but maybe she guessed herself. "Someone."

"Someone from school?" Mom sounded curious, but her eyes were narrow.

I had to tell eventually. "He's around my age, from the next town." I almost let them think I meant Kodari, but I didn't. "His name's Yinalu, Mom. He's a Thruha."

She got very quiet, and didn't move. Dad looked less worried, except when he looked at Mom. "I don't want you seeing it any more, Kevan."

"Why not? You and Dad work with them, don't you? And he's not an 'it.'"

"I don't want your arguments, Kevan Leonard." Great. The middle name.

Dad butted in. "If he's your age, son, he isn't a he yet, or a she. Maybe if—"

"We'll discuss this later, Anton. Kevan, finish your dinner, then go upstairs."

I obeyed, but I left the door open a crack and sat by it. I hated when they argued, but I had to hear. Their voices got loud enough soon.

"—what we're working toward, Tyra, forming a bond between ourselves and the Thruha."

"Wrong. We're working to understand them. That should inform our decision to become more cordial, not presuppose it. We've been on Terai twenty-six years; the Committee's been working almost as long, and still we don't really comprehend them."

"We will."

"Perhaps. . . . and I suspect we won't like what we comprehend."

"That's the popular prejudice, Tyra, the one denying our efforts any official support."

"Popular doesn't mean untrue, Anton." I almost shut the door, her voice was so cold. "They don't think like us. They don't feel things the way we do. They could be dangerous, and I won't risk Kevan on your intuition."

Dad didn't answer for a while, and he was tough to hear when he did. "Can we at least think this over now and again, not make any irrevocable decisions?"

I didn't even hear murmurs for a long time after that. I finally closed the door, gently, and got into bed. I don't remember when I fell asleep, or when I stopped shaking.

I had plenty of time indoors the next week, thanks to Mom. I did my homework early each day, so I'd have time to learn things about the Thruha from Spock's Brain.

Dad told me once why our colony's primary computer is called that. Some really old video program, and part of it happened in the Sigma Draconis system, where we are. He says it's a great joke, but he never keeps his promise to show it to me.

Anyway, Spock had loads of files, but most of them were technical, not for kids. I wasted half my time dumping those. The rest didn't say much I hadn't known.

Yeah, young Thruha don't have sexes. I learned that in school; Dad didn't have to tell me. But what else was I gonna call him? I knew about those spots on his hands, even if I didn't know the word *neurotransceptor*, and I knew they communicate sometimes that way when they're close together. I sure knew plenty of humans were scared of them.

I learned some of the history in school, too, but I read more about it. They beat our first colony ship here by months, but didn't object when humans settled here anyway. The colony heads didn't want to be so close, but there isn't very much habitable area on Terai.

Part of that's Bruiser's fault. Supposedly it got caught into orbit a million years, Earth years, ago. That shook up the weather, started the huge tides that make coasts uninhabitable, and killed off lots of species. It's slowing our rotation too, close to a second a year. Dad says someday our thirteen-hour day will end up as long as Earth's. He always talks about Earth.

The climate was harsh enough already—hot, rainy, thick air—so only high, shielded plateaus are comfortable for humans, or Thruha. There's only one big place like that on Terai, and here we are.

We get along the way I get along when Mom's angry at me. We stay out of their way. Mom, Dad, and others are working with a few of them on translating our languages, but mostly humans try to pretend they aren't there, and do a lousy job of that.

After school Late Friday, I saw Dad when he was alone. "Did you and Mom decide I still can't go out this weekend?"

He turned down his screen and thought for a while. "When did you intend on going?"

"Late Saturday, after dinner." I had that worked out.

Dad nodded, barely moving his head. "Mom will know you have homework, son. You'll have to tell her. Now scoot. I've got tests to write."

I left, confused and disappointed. I started getting it done that night, rather than watching video or accessing the Game Room. I finished after dark Early Saturday, before lunch, and meant to tell Dad.

He walked into the kitchen with Mom and me, holding an asset strip in a reader. He kissed Mom, and showed her.

"The recital tonight?" she said, then kissed him back. "That's so sweet. Thank you." She looked at the reader again. "Two seats? Why not three?"

"I didn't know if Kevan wanted to go." He turned my way. "Care to come along, Kev?"

"Uh . . ." I almost smiled, but stopped myself. "I can't. I still have homework." I looked Mom straight in the eye. "They gave me lots this weekend. I'm sorry."

"Don't be, Kevan. That's very responsible of you." She smiled back at Dad. "And very thoughtful of you."

It sure was.

They left after dinner. So did I.

I finally thought I knew how to win a race. I showed Yinalu the halfway tree, as far off as the other, with a couple of lacebushes right between. I went and jumped over them, so he'd know what I meant, and we went back.

I got close. He slowed down more than I did jumping, and I almost passed him turning at the tree, but he still won. We started again right away. He got farther ahead this time, but running back to the bushes, he tripped on his hop over and fell. Not hard, but he was down.

I shouted. I was gonna win. I was so excited, I forgot to jump.

I stopped rolling next to him, wearing half a bush. He almost got up, but started clucking so hard he ended up back on the ground. I laughed too. We didn't stop until I had picked everything off my clothes.

Yinalu looked at me, and his eyes did that thing again. "No." I started pulling my hand back, but seeing his mouth go thin changed my mind. I gave him my hand, let his fingers wrap around it, sorta like a Hanoi tree, biggest at the wrist.

He must have kept his nerve thing closed. I barely felt a tingle. But I still understood.

I had to tell someone, but picking who was hard. Tad was the best student in class: he knew everything. Luis was bigger than everyone else, so he wouldn't be afraid.

I told them I wanted them to meet somebody, first thing Early Sunday. Tad said sure, but Luis played all superior and uninterested. I had to dare him, and he promised I'd regret it if it wasn't somebody really interesting. I didn't worry about that.

Mom gave me permission when I told

her I was going exploring with other boys. She sounded relieved. I knew I was kinda lying, but not really lying.

She didn't let me outside until she saw Tad and Luis. I ran to meet them, so they wouldn't speak to Mom and spill anything. Dad quick-peeked out the window at us, like he knew.

Luis kept bugging me all the way about who the mystery person was, saying he was going home. I barely got him into the woods. He saw a shadow a long way away, and started running to see who it was. Before Tad and I caught up with him, he had stopped, his mouth wide open.

"That's—that's—one of them!"

"Sh! Don't shout." Yinalu was backing away. I jogged ahead, waving him to come closer, and he did. "Come on, you two. He's friendly, just a little shy."

Luis's pointing hand shook. "Y-you aren't supposed to meet with them. It's illegal or something. I'm not getting in trouble for this."

He started running away. "Come back, you big baby!" I shouted. He should have turned around and punched me. Instead he kept going.

Tad stayed, but he was nervous too. "Kevan, maybe we should head back to town."

"Not you too. Listen, you can just watch if you want." I ran to our favorite tree and started climbing it. "Coming, Yinalu? Try for *trach* this time."

He couldn't make it up to seven, so I climbed back to six. Tad was sitting on the ground way below us, picking at the feathermoss. "I thought you'd be excited," I called down. "Have you met Thruhas before?"

"No!" Like it really was illegal. "Do your parents know about . . . it?"

"They know about *him*," I said, leaving out their different opinions. Yinalu and I climbed down. "Stay there, Tad. You'll be braver than Luis." I walked Yinalu over. "See? It's okay."

Tad made himself look, then didn't mind so much. "Is he an adult? You called him he."

"No, but gimme a break. Does he look like a girl?"

Tad sneered at me. He stared at Yinalu, too much, but I was the same way at first. "Does he speak English?"

"No. We've taught each other numbers, a couple other words."

"And you come here just to climb trees with him?"

"No, we do more. Whatever we feel like."

Tad asked more silly questions, until it started raining lightly. He used the excuse to go home, and I went too after a few minutes. I said I was sorry to Yinalu, but he hadn't learned that word yet.

It was still rainy when I got home. I had my shoes lying on the mat when I heard Mom. "Kevan Leonard Marek!" I knew what that meant. I almost got the door open, but she appeared outta nowhere and grabbed me.

"Mrs. Costas called us not long ago," she growled. "Do you know where her son Luis said you took him?"

I didn't dare answer. I looked around her, and saw Dad in the living room doorway. He stood there, not moving, with a disappointed frown. He couldn't help.

I was doomed.

Four months. Mom grounded me a whole half year. At least it wasn't one of Dad's Earth years.

Everybody in school found out about it. I heard Tad's parents punished him pretty badly. He wouldn't even sit next to me any more. A month later, his family moved.

Luis started specially torturing me, and nobody really cared. Okay, a couple kids cared, those who didn't think I did anything so wrong. I should have taken them instead. I mean that the teacher and principal didn't pay attention. Mom said I had to bear the consequences, and Dad didn't argue.

Establishment Day was terrible. My birthday was worse, especially with Dad treating it like a 'real' birthday, trying to cheer me up. I wanted him to stop, and let me be miserable.

I thought about Yinalu: how he must have waited for me, how he must have been sad and disappointed, how he'd think I wasn't his friend any more. How could I explain when I saw him again—if I ever did?

I watched Mom and Dad in the workroom one night, conferencing with their Translation Committee. They talked more about computers than language, with sub-algorithms and context sorts. When it ended, Mom went into the next room, while Dad stayed.

I walked in on tiptoe. "Dad? I was wondering . . . could you teach me their language?"

His forehead got wrinkled. "Kev, *Kiitmantel* is pretty tough. We haven't completely cracked it in a good twenty years."

"But you can use it. You talk with their scientists all the time."

"Yes," he admitted, "and sometimes we still get confused." He looked at me, kinda smiling, and put his arm around my shoulders. "I can pare down one of our programs, rework it into a tutorial. Can you give me a week?"

"Sure, Dad."

"Now, you have to take it slow. I don't want your schoolwork slipping." I nodded. "And your mother has to know what we're doing."

"Dad, no!" I whisper-shouted.

"Kevan, what happened the last time you did something without her permission? Besides, she works with *Kiitmantel* also. She can help guide you."

Mom came back, and despite my desperate, half-hidden gestures, he told her everything. "I think that might be good for him," she said, "if it's handled right. He could learn something meaningful."

Just what I wanted.

I worked through Dad's tutorial kinda slowly. The language is difficult. I learned words, and could put them together, but—it's hard to explain—they didn't feel like sentences. I could speak like a Thruha, but not think like one.

That mattered. I didn't want Yinalu hearing something different from what I was saying, even if he followed me. I wanted comprehension. I wasn't getting it.

I got so frustrated about it, I actually told Mom this when she was checking up on me once. "What about the language is different?" she asked, like she expected a certain answer.

"Well, take the words for "I'm sorry."" The first words I looked up on the tutorial. "They don't—*sound* sorry."

That was what she expected, and she looked it. "That's because Thruhas think differently from us, Kevan. They don't experience emotions the same way we do."

"Because they're aliens?"

"Because they're Thruhas. There's no saying what other aliens would be like, but we know about Thruhas. Things that would affect us don't touch them."

"Like being sorry for something?"

She sighed. "They would *be* sorry, they would regret something happened, but they wouldn't *feel* sorry, not the way you or I would. Their brains work differently—much differently."

"You mean like their nerve links?"

Her face went rigid, pale. "Yes, Kevan, like that. Do you have more questions?"

"Not now, no." Of course I did, but nothing I wanted to talk about with her. She patted my head and left me alone, which was good.

Things I'd heard people saying for years finally started making sense. Thruhas were like computers, they'd say. Dispassionate, calculating, machine-like. As if computers were dangerous—but maybe they would be if we didn't run them, but they ran themselves.

Their nerve links would help them work like computers, too. I'd learned enough to know one big processor doesn't work as well as lots of smaller parallel processors. The Thruhas could share ideas, and make plans, that we'd never know about. Until it was too late.

That's what lots of humans thought. They imagined Thruhas all linked in circles, plotting what they were going to do to us, years from now, or soon. Nobody ever saw these circles, but nobody saw much of anything about Thruhas, so who could argue? It was easier to be a little scared, because scared meant careful.

I could figure out why they thought that way, but for me it didn't add up. I knew Yinalu. He wasn't like that. What was different? Who was wrong?

Maybe they acted differently alone than linked up. Maybe Thruha children weren't the same way adults were. Maybe Yinalu was just strange, a misfit.

Maybe I didn't know better. I was twenty years old, just a kid.

It got way into spring, two months after my grounding ended, before I really thought about going back to the woods.

There was no point, though. I couldn't go back. I was kidding myself.

Dad looked in on me one day while I was studying. "How are your—" He peeked back into the hall. "—language studies coming?"

"I'm not that interested these days. I don't learn that fast, and—it's useless."

"Does that mean you don't want to see your friend anymore?"

"It means I can't. I'd like to see Yinalu, but I wouldn't live long enough for all the punishment I'd get." I turned my back, trying to look studious.

"If there weren't any punishment, would you?"

"Yeah," I said, uninterested in pretending.

"Okay, Kev. Don't say anything to Mom yourself, but I'll speak to her about it. She might not be as much against it as she was."

"She is too. You shoulda heard that lecture she gave me when my grounding ended. Thanks anyway, Dad, really, but it won't work. Sorry."

"It might work. Be positive." He paused. "Besides, if she doesn't change her mind, we can try some other method."

That made me turn around. "No. Dad, don't. I don't—I don't want you in trouble too."

We both got quiet, then ended up hugging. I guess he started it.

"Let me worry about that. Just keep this to yourself for now, okay?"

I nodded against his shoulder. I didn't argue again. I wanted him to succeed too much.

I heard them a couple days later, before going to bed. I shut the door fast. Their voices still got through sometimes.

It happened again a few days later. I almost went downstairs to tell Dad to stop trying, but I made him a promise. I stayed upstairs.

Mom began looking in on me more often. Nothing to discover. I wasn't doing anything wrong yet. She tried not to look glad that I was letting my *Kittmantel* studies slip. Guess she thought I'd learned the real lesson.

I went to see Dad when he was working alone. He knew what I was gonna say. "Keep calm," he said before I could open my mouth. "I'm working on it."

That was all I heard about it for over a week. I guessed he had forgotten, or given up, so I didn't expect anything dramatic to happen. Something did, but not from him.

Mom just said it out of nowhere during supper. "Kevan, your father tells me you could be doing better at your science studies."

"What?" Science wasn't my best subject, but I was doing all right. I looked at Dad for help.

"Your marks have slipped, son."

Whenever you know things can't get worse, they do.

I knew enough to respond humbly. "What do I have to do?"

"We know a teacher," Mom said. "She's on the Translation Committee, and she works with Anton at the high school. We're going to arrange tutoring sessions on weekends."

"I'll take you to her house Early Saturday to meet her," Dad added. "We'll work out a schedule for times to go there."

"I have to go there? Every weekend? Why can't she tutor me over the computer?"

Dad looked hard at me. "We decided it would be better this way, Kevan."

I almost blew it there. I stuffed food into my mouth fast, and lowered my eyes. I bet I looked really sorry for myself.

I wasn't completely sure until Dad was halfway through driving me there. "You do understand that Miss Levitski won't be tutoring you."

"Yes. I mean, I was kinda sure."

"I don't have to explain how secret this is. Now it's your responsibility to improve your science grades. Miss Levitski will give you a few files if you really need them."

"I'll do better."

"I know you can. Now, do you know when your friend would come looking for you?"

"Probably. They go by three-day schedules, not two like us."

"We're familiar with that, and I'm guessing you've kept track of those days." It wasn't really a question, so I didn't really answer. "Will he still be coming?"

"Maybe. It's been a long time."

"I know, Kevan, I know. Miss Levitski and I are going to ask you questions about him today. We'd like to learn more about Thruhas than what studying their language tells us. We'll also want to do that sometimes after you've visited with him. Can you be patient with us about that?"

"I can." Then, "Thanks."

He tousled my hair. "If you help us enough, we're the ones who'll want to thank you."

I talked with Rachel. She told me to call her that. She did ask lots of questions, and I couldn't answer many of them. I didn't know enough.

She and Dad talked about what they'd learned. I got the impression they were keeping things hidden, not just from Mom, but from others in the Committee. I wondered how much they kept from me, too.

We worked out times. Rachel would tell Mom she had a variable schedule, to explain all the changing days. Mom hated that, but she put up with it, "for his sake."

It worked fine that first Early Saturday. Dad drove me to Rachel's house, dropped me off, and drove back to Mom's. I walked in the front door, for anyone watching, then out the back. She lives on the edge of town, so I could head straight for the woods.

It looked just like I remembered. Our Hanoi tree had a tiny sprout of buds at the very top, the start of a thirteenth canopy, but that was the only real change. I started waiting.

I kept waiting.

I looked around the woods for other places Yinalu might have gone. I climbed our tree to look at the path from his town. When time got really short, I even walked a little way toward Yinalu's town.

I had to leave, to get back for Dad to drive me home. He and Rachel still wanted to try again next weekend. So did I.

We went through the routine again the next Late Saturday. I got to the woods again, and he wasn't there again. I almost went right back to Rachel's house. Instead, I sat against the tree, arms around my knees, head tucked down, wishing none of this had ever happened.

Something touched my shoulder. I brushed at it, only to get tapped again. I scootched around the trunk. I didn't know what it was, until I heard, "Kevan?"

He'd grown a little more than me, his hair-fuzz was thicker, but I knew him. I stammered four times before I remembered what I'd memorized. "I'm glad you came back," I told him in *Kiitmantel* . . . then "I'm sorry."

I couldn't follow everything he said, except where he thought he could climb seven branches up our Hanoi tree. He did, too . . . but I still got up nine.

I explained when we could visit each other, in short words and sentences. Yinalu agreed, and understood not to give up if I missed a week.

We picked up pretty much where we left off, which was having fun. One week he brought a boomerang that we tossed around. The next week he brought a ball that had holes that opened when it began falling. That made it tough to catch, and lots more fun to try.

We did miss a week because it rained too hard. A couple of weeks later it started pouring halfway through our time. I hurried right back to Rachel's, but I was still completely soaked. I thought she'd never get everything dry, that Mom was sure to catch us. Dad explained my dampness as coming from walking to and from his car, though, and we got away with it.

That gave me an idea for next week. I led Yinalu southeast from the woods, toward the river that passed by his hometown. It wasn't until I had most of my clothes off and explained how we'd race to the other bank that he told me he couldn't swim.

Dad and Rachel asked whether that meant just him, or all Thruhas. I did ask—I knew they'd want to know—but he didn't explain much more. I guessed he meant just him, but they wanted more than guesses.

They expected me to ask Yinalu all sorts of things. I tried sometimes, but my *Kiitmantel* wasn't that good, and that wasn't why I liked seeing him. They understood that, sorta, but it didn't stop them.

We had to break off for winter. I could speak well enough to Yinalu that he knew I'd come back after a while. It was tough leaving that last time, even though I knew it wasn't forever.

Dad took me back to Rachel's next weekend for another questioning. Rachel treated it kinda special, dressing herself up. Don't know why she bothered. She and Dad just asked things they'd asked before, questions I still couldn't answer.

"I'm not really helping, am I?"

They looked at each other, amazed I had asked *them* something. "Every piece of data helps," Rachel said. "It gets us closer to knowing what Thruhas are like."

"Why don't *you* ask them? Why not meet with some of them yourselves?"

Dad made a superior smile. "Kevan, you know full well how humans react to other humans having contact with Thruhas."

"Yeah, 'cause you make me the only one!"

"That's not fair, son."

Rachel broke us up. "Kevan, we do talk with Thruhas sometimes. We have counterparts trying to learn about humans, like we want to learn about them. The trouble is, they help us with their language, but they keep their social and cultural customs to themselves, and they don't like us asking about them."

"Oh. Why not?"

"They won't tell us that, either. So, we work hard on their language, and learn what we can about them from it."

I almost fell off my chair. "Gee, no wonder people think they're robots or something. You're only reading their schoolbooks, the most boring things. You don't read their stories."

That startled Dad. "Did somebody tell you that? Did you, Rachel?"

"I didn't. Our blind spot must be pretty obvious."

"Or maybe I'm just smart."

They laughed a little. "That, too," Dad said. He looked at Rachel. "The Translation Committee debated this years ago, and rejected it."

"Like you said, Anton, years ago. We also have a much broader knowledge base today. Maybe it's time to reopen the debate."

"But would the Thruhas even cooperate? I suppose if we frame the request right, say we need experience interpreting colloquial language . . . the worst they could say is 'no.'"

"Guys." Their heads turned together. "If you do get some stories from them, get a couple that I'd like to read."

Dad grinned, the way I like. "If we succeed, Kev, that'll be your reward."

The Committee's argument—it didn't sound like a debate—got pretty intense. Mom and Dad didn't notice me watching their first cyberconference for over half an hour.

Like usual, my parents disagreed, but not really that badly this time. Mom was pretty calm, which probably explains why Dad sounded so good making his points. They started scheduling another meeting, and I snuck away into the kitchen before they caught me spying.

They came in right afterward. Mom was complaining about some members throwing off their schedule. "Stuck-up little God-heads," she grouched. Dad stayed out of her way now.

Mom doesn't really hate religious people. The Terran Conventional sects go by Earth time for Sabbaths, and that's a nuisance for people living just by Terai time. My tutoring schedule pushed the same 'grumpy' buttons on her.

I didn't see their other conferences. The way Mom was looking less upset each time, I assumed she was winning. I was surprised when Dad came in after my studies one day, smiling.

"Congratulations, Kev. The Thruhas are giving us fiction to translate." He squeezed me hard. "And a deal's a deal. You get the first one."

I had to wait a month. Dad said they needed to readjust their translation algorithms. When it was finally ready, he gave me the file address where I could access it through Spock's Brain.

"Try not to be disappointed," he said. I asked what he meant, but he was already going.

The file was copy-protected, so I couldn't download it. I had to read straight from the monitor, and make sure Mom wasn't around. Actually, I was glad nobody was around.

The story was about a kid whose parents were always moving around, never letting him keep friends or get used to places. It was written for juveniles, Dad said. I wouldn't have believed it.

It seemed written for grown-ups, always assuming you knew things that you didn't. You knew Mivchiwu had to be sad, but the story barely ever said so. Sometimes characters would nerve-bond—with the palm things—and whatever they told each other, the writer didn't tell you. You could kinda figure it out from how they acted later. That was all.

Rimag Trachep—some kind of plant seed on the Thruhas' home planet—was a weird story. I didn't have to tell Dad I didn't enjoy it: he'd known I wouldn't. He didn't either.

I had faked improving at science enough so we could leave off the 'tutoring' for the winter. I began letting things slip so Dad could have an excuse to start me up again. Mom was 'very displeased.' That always hurt.

Dad took me to Rachel a week early, supposedly to observe how she tutored me. They explained what kinds of questions they wanted me to ask Yinalu. "Why don't you go and ask him?" I said.

"He knows you," Dad answered. "He may not respond favorably to us. Remember, he didn't get along with those boys you took to the woods."

"*They* didn't get along with *him*."

"We're doing what we can," Rachel said, "but we want your help as well. Unless you'd rather not work with us."

Dad whispered something harsh at her, but the message had already gotten through. "I'll keep going. Just—you will keep working with their stories, right?"

"We haven't stopped," she said weakly. "We're still trying to understand the mindset."

"Hm. How about finding stories with humans in them?"

Rachel's eyes got big, but Dad stopped her before she could talk. "Why, Kev?"

"Well . . . finding out what they think of us could help decide what we think of them."

"Told you he was smart." Dad probably thought I didn't hear that. "We've started trying exactly that, but the Thruhas are saying their books don't have us in them."

"Well, that's dumb. Why wouldn't they?"

They both looked at me like I had the answer. More like I could find it out.

Yinalu was at our Hanoi tree even before I arrived. We did some of our usual playing for an hour, but I didn't really enjoy myself. I was putting off my responsibility.

He had his quiet time during a Bruiser eclipse. That gave me my chance. Before he could get up, I sat down by him. "What do Thruhas think of humans?" I asked the best I could.

Yinalu's mouth got really small. "They do not like you not," he finally said.

"Uh, they don't dislike us?" I said back slowly. He up-nodded, kinda diagonally. "But they don't like us either. Why not?"

He took a long time answering. "They do not think—they believe humans—" He got up and paced. "I cannot tell you. You will not like me."

"I will." I got up after him. "What they think won't make a difference with us—unless you agree with them."

"No. I know you are—" He grabbed my hand. I got a quick jolt from his nerve patch before he pulled back, looking sorry.

I walked forward. "Yinalu, if we could talk this way—" I took back his hand. No shock now. "—would you be able to tell me?"

He didn't move. "Yes."

"Then why can't you tell me by talking?"

"I . . . can't." He squirmed loose and ran, like he'd die if he stayed.

"Yinalu! Come back!" I went after him a ways, but he could always outrun me. I watched until he got too small to follow. Then I ran back myself.

I was out of breath when I came in Rachel's back door. "I asked him your questions!" I shouted before she could say anything. "He ran away! I'll never see him again! *I hate you!*" I stormed out the front door so she couldn't try to apologize, like she would.

Dad passed me in his car when I was already halfway home. I almost didn't get in when he turned around, but I had to tell somebody. He drove us around until I told him everything, and until he thought I'd stopped being immature.

"It'll be okay," he said. "It isn't as bad as you think. He will come back. Don't be so upset—and don't get Mom suspicious."

I didn't care about Mom—much. I finally agreed with him. I didn't tell her anything, but she saw over lunch I was still upset.

"This should be a lesson, Kevan. If you had studied harder before, you wouldn't be losing parts of your weekends now. Stop leaning on the table."

Dad was right. Yinalu was back Early Saturday. We ended up doing nothing for a while. I had to talk. They expected me to talk, but I couldn't start. So he did.

"Kevan, I regret our parting four days past." That's Thruhas' calendar. "I do not dislike you."

"I don't dislike you, either. We don't

have to talk if it—isn't something you want." I didn't know a good word for *upset.* "It's something I want, though."

Yinalu wandered around a while, and I was afraid to follow. When he walked back, he said, "Can we only play today?"

Whatever was sitting on my chest got up. "Sure." I went to pick up the model glider I'd brought. "Let's see how far we can make this fly."

I told Rachel Yinalu wouldn't stay if I asked him questions. I thought that would make her sorry, but she asked questions about exactly how he had refused to answer questions. You can't win sometimes.

Dad arrived just as the Sun was going down. I went to meet him at the door, but he walked past me. "They're out," he told Rachel.

"What are?" She got pale. "The Thruha stories?"

"Someone gave out the file names. I don't know who. People are reading them, and reacting."

"Is that so bad?" They both looked at me funny. "I didn't tell anyone, honest."

"No, you couldn't have. They released file names for our analyses of the stories, too. You didn't have those to give away, Kev."

Rachel got right next to him. "Could we withdraw the files? It might not be too—"

"It is too late, Rachel. Somebody took visual scans of monitors, reproduced the files without having to break the copy protection. Erasing our files would inflame matters."

"Okay, let's not panic. It's just stories, plus our boring dissections. The general populace will ignore this."

Dad's shoulders sagged. "Now why don't I believe they will?"

They didn't.

Dad gave me a talk about reinforced stereotypes and feedback loops. Mom gave her own lecture, about how some people cling to convictions even after they're disproved.

People got awfully upset awfully fast. Everybody was talking about Thruhas being soulless—and those weren't just Mom's "God-heads." They were cold and heartless as Spock's Brain, inscrutable, conniving—everything I'd heard before, just worse.

Schoolmates who had forgotten about my knowing a Thruha remembered. Some avoided me because of it. Some picked on me, led by Luis. He became some kind of hero because he'd run away. He made up stories about Yinalu, and made sure nobody believed me when I said he was lying.

Dad had worried that the Translation Committee would get ostracized. I thought that meant getting your neck stretched out like an ostrich's. He said he'd prefer that, but that most people didn't react the way he thought. They wanted the committee to learn all they could about Thruhas—so they'd know how to defend themselves.

There was talk of sending for help. Earth is almost six months away, round-trip; the Nieuw Batavians on Eta Cassiopeiae are over three months. And we had one FTL ship, for emergencies. They thought this might be one.

Some thought that wouldn't even help. Earth has been colonizing in the other direction ever since we found the Thruhas here. They neglected us. We were expendable. We had to fend for ourselves, which to them meant getting the Thruhas first.

It was scary listening to all this, but I figured not enough people agreed on anything to make it happen. What really scared me was what happened Late Wednesday.

I've never heard them fight worse. I covered my ears in my room, and still heard. Dad believed she had given out the file addresses, or Mom thought he thought so. I kept covered after it got quiet, until I felt noises in the spare bedroom through my wall. I knew who went in there.

* * *

I made it to Early Saturday somehow, and even managed to stay calm when Mom drove me over to the Levitski house. (She forbade me to call her Rachel.) It was drizzling, but not enough to keep me from heading to the woods, after I was sure Mom had left.

Yinalu had brought a flying disk, just like ones I've played with sometimes. It helped me forget things, for a while. We had a second short rainfall, not bad. By the time it ended, I knew we had to talk.

He must have known, too. "We have no time," he said, pointing at the setting Sun. "We do not come to talk here."

"I do." How could I explain? "Humans don't understand what Thruhas are like. Bad things could happen, terrible things. I need to learn more. You have to help me. It's important."

Yinalu trotted to the trunk of our Hanoi tree. "High as you," he said, and started climbing.

Why wasn't he listening? Well, he couldn't run away in a tree. I scrambled after him.

I expected him to quit at seven, but when I got there, he went up to eight. He really was getting better. I followed, slowly because the tree was still wet, and poked my head through the canopy, almost into a diamond-glider nest.

"Good?" Yinalu asked.

"Yeah." I pulled myself onto a limb close to his. "Yinalu, please, let's talk."

"Please, let's not. Let's be friends."

"Why would talking make us not friends? Tell me."

First he wouldn't say anything. Then he said, "Nine."

"Huh?" Then I saw him climbing again. "Hey, wait." After all the rain, I wasn't sure I'd even follow him.

The trunk was small enough that his fingers met around it. He inched up, arms, legs, arms, legs, until he reached the ninth canopy. He grabbed for a branch, and that's when the bark gave way.

He landed hard across two branches on my level. I lunged over, but he stopped there. He looked up, mouth wide and crooked, and started lifting himself up.

And slipped again.

I almost fell off reaching for him, but he dropped too fast. He slowed himself grabbing at branches for a while. Then he went limp going through the fourth level, and there were just cracks and a thump after.

I climbed down as fast as I could. I put my foot on a branch on the second level that he must have hit, because it came loose. I landed right on my back, and screamed from the pain.

Rolling over hurt, but I had to find him. He was right next to me, unconscious, with his arm bent crazily in two places too many. Part of his head was getting dark and swelling. He was breathing. Barely.

I screamed for help, like an idiot. We were kilometers away from anybody. Standing squeezed tears out of my eyes. Lifting Yinalu was like being stabbed through the back, and each step was worse. I kept going—I had to—down the hillside, toward the Thruha town.

I stumbled once, hitting my knee on a rock. I didn't drop Yinalu. I would have died first. I thought I was gonna for a while.

For the first time, I wished I lived on Earth. Better, on Mars or Luna, with really light gravity. None of this would have happened.

I reached the edge of town. The Sun was behind the hills; the sky was green at the horizon. Nobody was outside their houses, all cylinders and domes. Where could they be?

I shouted for help, and nobody came. I kept walking, past a dozen houses. I couldn't stop. My voice was like I had a bad cold, getting weaker.

I suddenly remembered their language, and coughed out a few words. My bad knee gave out, but I cushioned Yinalu with my arms. I kept saying "Please," and I don't know in what language.

When I looked up, two adult Thruhas were slowly stepping closer, carrying sticks with carved middles. I told them Yinalu had fallen, to get help, to please not hurt me. I left him lying on the ground, so they could approach him without getting near me.

They nerve-linked for a minute, then one said something about 'help,' and the other went into a house. I started backing away, back toward home. Maybe it wasn't too late, if I hurried.

Two red vehicles came, blocking the street. I tried to go around, but Thruhas came out and stopped me. "No, please, let me go. I have to go home. Please!"

Two of them grabbed me, putting me in their car. I saw the other car drive close to Yinalu, and occupants get out to put him inside. "Okay, you got him. You don't need me. I didn't hurt him. I'm telling the truth." I didn't know how to say "I swear."

The others got into my car, one in front to drive, the other to watch me. We started following the first red car, but I didn't watch long. I lay down, balancing on the narrow seat, crying so hard I didn't know from what, sobbing over and over, "I'm so dead . . . I am so dead. . . ."

They left me in a little dark room at the hospital for hours. Someone came in once, probably a doctor. He made me get undressed, and looked where I'd hurt my back and knee. I talked, but he didn't seem to listen. He looked between my legs for the longest time, before making little clucking sounds and leaving. I was too hurt and tired to be mad. Ashamed, maybe.

I dozed on a chair, who knows how long. There was a little light outside their clouded windows when another Thruha entered. I almost started stripping again, but he gestured for me to come outside.

There were two Thruhas standing in the hall, linked at both hands. The other interrupted carefully, and spoke softly to them. "This is the human that brought your child." I was pretty sure he said that.

They broke up and looked at me. The female, Yinalu's mother, came closer. His father put his back against the wall. I was all cried out, but when I started explaining again what happened, it came out whimpering.

His mom knelt. "Were you seeing it when it went out alone?"

I nodded, my way, then theirs. "All the time. He's—it's—my best friend."

She reached for my hand, then recoiled. His dad whispered something like "It's obvious" at her. She stood and went back to him.

The other one herded me back toward my room. "Wait. Wait! Will Yinalu be all right?"

His parents were walking away, and didn't answer.

It wasn't much longer before three Thruhas arrived. "We are to see you return home," one of them said, slowly, in easy words.

"Is Yinalu alive? Is he—it—going to live? Why won't you tell me?"

They consulted with some looks. "The child remains alive." I almost cried again. "We will take you now."

"No. I have to go myself." If I walked back myself, I could tell everyone I ran away during my tutoring. I'd be in incredible trouble, especially for getting hurt, but better than having them learn everything.

They tried to argue, about their arrangements, and my injuries, but I outlasted them. I let them drive me back to where I entered town, and then I walked away, slowly, but alone. The time it took let me think, start making things I'd seen make sense.

An hour later, I started hearing noises in the woods. I went faster, hoping to spot them before they saw me. I didn't.

"Here he is!" a woman shouted. People came swarming out of the trees. She got there first, putting her arm right where I hit my back. She let go quick enough. "What happened to you, Kevan?"

I started my story. "I fell out of a tree. My tutor and I had this big fight, I left, and—"

Two big men came up behind her. "What did they do to him?" one growled.

"Get him back first," said the other. "See he's all right, then we'll worry about them."

I couldn't say anything. I didn't know how much they knew. I couldn't trust anybody—except one person.

I kept asking everybody for Dad, from the rescue team to the doctor and nurses who examined me to the orderly who brought me supper. They all kept reassuring me he'd come. So of course my first visitor was Mom.

She'd been crying, but now her eyes were narrow. When she walked at me, I cringed. She saw that, and her face changed, a little. She hugged me gently. "How are you, Kevan?"

"Better." My cracked knee was immobile, my broken rib bandaged, and I had a painkiller collar hanging on my shoulder blades. I was better, that way. "Where's Dad?"

She let go, angry again. "I don't know. Kevan, your father has treated you horribly. He's done very bad things, and he was wrong to make you help him."

"No." The rib pinched, and I didn't care. "No, Mom, he was right. I've figured it out, at least some. I've gotta tell him."

"Kevan, he won't come. I've forbidden it, after all he's admitted doing."

"No, you can't. No! *No!!*"

I struggled, but she held me down. Orderlies came in to help her—then someone appeared behind them. "Kevan!"

"Dad!" I almost got loose. He almost got to me, before an orderly grabbed him. "Get him out," Mom said. "He's done enough damage."

With one more try, I got free. I gripped Dad's hand, exactly the way a Thruha would. I made sure he saw my face, all the love and fear and urgency there.

I nodded. He nodded back, just before the orderlies yanked him away. A nurse appeared, put a key in my collar, and changed the setting. I fell asleep right away.

It was all right, though. He understood. Maybe it wasn't too late.

Nobody would tell me what was happening the next few days. Mom made little visits, and sent her parents to see me. She must have told them to keep quiet.

I hoped that was good. If fighting had started, wouldn't everyone talk about it?

I was stuck there, confined by regeneration accelerators. I couldn't get to a real bathroom, but they still brought in my schoolwork. I thought that was the start of my punishment.

Then for all of Wednesday, no visitors came. Still nobody told me what was happening. Telling me they'd release me Thursday didn't help. I barely slept.

They took me off the regenerators, tested me, and cleared me to leave. I had to wear my dirty clothes from Saturday, the only ones I had there. I sat in my room, waiting for someone to pick me up, miserable—until someone arrived.

Dad's hug was weak and tired. I started asking him a million questions, but he told me to wait. I almost burst walking to the car with him.

Inside, he gave me another long hug. "How did you know, Kev?"

"I . . . knew. When I saw Yinalu's parents linked up, I figured that's all it could be."

"Wait. His parents?"

I explained what happened, from the beginning. It was the first time I had told anybody who would listen. "Do you know if he's all right?"

"I don't know. Sorry."

"But you've been talking with them, haven't you?"

He smiled thinly. "More than you can imagine. Their social strictures were almost impossible to break."

"What strictures?"

Now he got to explain. "Son, Thruhas express their feelings, strong feelings, only through the neurotransceptors. Deep emotions are very private to them. Showing them outwardly is—almost unthinkable. Even discussing them scientifically occurs through links."

"Then they wouldn't talk about them to you?"

"Not until half our committee had worn itself out trying. I was afraid for a while that you were wrong, but we kept trying. We told them how close human fears were coming to violence. That looming crisis is probably all that broke their resistance."

"Sounds like Yinalu." Dad tipped his head, a lot like Yinalu actually. "Because I couldn't make him talk about some things, like what Thruhas think of humans."

He looked away solemnly. "With good reason. Kevan, as much as humans have mistrusted and misjudged Thruhas, they've thought similar things of us."

"Like?"

Rain began spattering onto the car. "Once they began talking, lots of facts came out. One was that many Thruhas, even most, think of humans as—animals."

I stared. "That's stupid! We build cities and starships. We talk!"

"Our intelligence wasn't the point. Our emotions were. Open emotions, passions they would never reveal to the eye or ear. That made the difference, to their viewpoint.

"Apparently, Kev, there's another intelligent species on the Thruhas' homeworld. They have no nerve links, so their emotions are overt, and they also never developed civilization. Thruhas causally connect the two, rightly or wrongly. The inertia of that conclusion extended to us, despite starships and language.

"Their whole definition of personhood is different from ours, emotional as well as intellectual. We failed their test. Now, maybe, they're thinking of applying a different test." He pulled me over by the shoulder. "And a lot of that is due to you."

I stopped myself from crying this time. Maybe I wanted to pass that test. "Thanks, Dad. Can we go home now?"

He separated from me. "We need to discuss that. You'll be staying at your grandmother's house for a while. I'll move whatever you need over there."

"What? Dad, why can't I come home?"

He looked away. "Your mother and I have—a lot of work to do." He started the car.

They did have work, conferring with their Thruha colleagues, and later Thruha officials. Leaders in Kathmandu started demanding they be part of the talks. The Translation Committee finally had its support, after its big work was finished.

Dad sent the news to me the first weekend at Grandma's. Yinalu was alive, and he'd told the other Thruhas what happened. They hadn't completely believed my version before then. Now they sent what Dad called "an acknowledgment." They were welcome.

I kept asking to see Yinalu, but I was "a low priority" for a couple weeks. You wouldn't think that the way kids at school treated me. Completely opposite. Everybody wanted to be my friend, even Luis. Well, I didn't need friends like that. I had a better one already.

When it finally happened, I almost wished it hadn't. All those people filming me for the newspages; all those politicians getting themselves into the shots. The Thruhas meeting us looked like they were rethinking their rethinking.

Yinalu was still confined to bed, with tubes stuck in his body instead of regenerating machines. I posed by him, spoke to him in English and *Kiitmantel*, like they instructed me. Whenever I tried to say something off the script, someone asked me a useless question.

When they finally shut up, it was because everyone was being hustled out, me included. "I'm staying," I told the chief of our visiting group. "I'm going to talk with Yinalu, alone. No one else."

"Kevan, you've met him, like we promised. Now we—"

"Alone." I turned to a nearby Thruha and repeated myself, very calmly. The chief asked someone for translation. Before he got it, the Thruha began motioning the others through the door. She was last out, leaving me inside.

Yinalu looked so fragile, thinner and paler. "I'm so sorry," I said, walking to his bedside. "I tried to grab you, but I couldn't."

"I made me climb, Kevan, not you. Without you, I would be dead."

"Without me, you never would have climbed the tree. It's my fault."

"No, it's your merit. I am glad I learned to climb trees. I am glad I know you."

My chin started shivering. "You could have told me, Yinalu. About what your grown-ups thought of us. I wouldn't have been mad, honest."

His mouth got tight. "It would have hurt." He clucked. "Like falling from a tree. But I should have told you. You are . . . you."

He reached for my hands, and this time I stood the prickling. "You're not gonna yank out tubes and hurt yourself, are you?"

His mouth stretched. "They treat me like a baby here."

"Yeah. I know just what you mean."

His good arm pulled me right into him, his hand pressing on the back of my neck. We stayed like that a long time.

I promised I'd see him again really soon. I never did.

I asked Yinalu to come to the woods at our arranged time when he was better. A few weeks later, I asked Dad to find out if he had left the hospital.

I was back home by that time. Mom had gone quiet, passive—and her workspace was cluttered. It was like living in another house.

Dad didn't answer me for a long time. When I finally made him, he said he wasn't sure Yinalu would come see me. "No, Yinalu isn't dead," he assured me. "Things have just changed."

"He's my friend. That won't change."

All Dad would say was, "Don't get your hopes up."

I wasn't hoping, I was certain. When weeks went by, and he didn't come to our spot, I got more angry than sad. I even took it out on Dad, until it was plain he had nothing to do with Yinalu's absence.

Around then, the rumors started spreading. The Thruhas had sent him and his family away, to a colony town far from Nepalganj. He had 'turned human,' people said, an unnatural act. Worse, some said his change was completely natural.

Thruha puberty turns a child from a neuter to one sex or another. The gossipers said which sex could be voluntary, and Yinalu had made himself Yinali. Female.

I've never believed them. I've started fights with classmates who teased me, even with so-called intellectual adults. They can say what they want about that new nerve patch they've learned about, at the back of the head. They're just talking to hear themselves.

They don't understand. Yinalu's my friend. That's all it ever was. I'm too young for anything else, just twenty-two now. They're all so obsessed, they can't understand.

I'll be back at our Hanoi tree next spring. Yinalu will come. Or Yinala: he'll turn into a boy, if anything.

Or even Yinali. It doesn't matter. She'd still be my friend. Forever.■

THE ALTERNATE VIEW Jeffery D. Kooistra

FIVE PREDICTIONS FOR CENTURY 21

Some of you readers may recall a couple of my longer stories from 1993—"Sunshine, Genius, and Rust" from the May issue, and "Young Again" from December. These stories were companion pieces to each other, neither really a prequel or sequel to the other. Each told a side of the story of how two geniuses, Samantha "Sunshine" MacTavish and James Christian Dykstra, were brought together to take on the threat to humanity brought about by our first contact with some nasty aliens.

It was evident by the end of those stories that a war with the aliens was probably inevitable. The reason I'm bringing this up now is because I just signed a contract with a publisher for the rights to the novel that tells what happened next. Now, publishing being what it is, I'm not going to be convinced that I'll really have a novel in print until I'm holding it in my hands. But by the time this column hits the stands I'll either have delivered a satisfactory final product or the deal will be off.

In my *Analog* stories I described Dykstra as being the "foremost genius of the age," that age being the twenty-first century. In "Young Again" Dykstra is 126 years old, and since that story takes place in the closing years of the twenty-first century, if Dykstra were real he'd be almost thirty right now. I filled up that future with a great deal of technology directly derivable from certain scientific breakthroughs that Dykstra had brought about. In the "In Times To Come" piece that Stan Schmidt wrote for the upcoming May 1993 issue, he described "Sunshine, Genius, and Rust" as having some "mind-stretchingly original ideas about how science might develop in the next century."

I don't know if this constitutes some kind of confession or not, but I never thought I had to stretch my mind all that much to make the projections I did. Had Nikola Tesla—the man responsible for the AC power system you use every day, the induction motor, and the real inventor of radio—achieved the fame of Albert Einstein (who was responsible for none of the technology we enjoy today, assertions by *Time* magazine in naming him Person of the Century notwithstanding), Tesla could have been our equivalent of Dykstra. All I did to make possible a future filled with FTL drives, force shields, and mass conversion devices was to invoke a paradigm shift, the sort of thing that happens in physics rather regularly, though not very often.

It should be no surprise to any of my readers that I think we're in the midst of a paradigm shift right now—and not a little one, like what happened with the advent of quantum mechanics, but a big one, like what happened with the Copernican revolution. (Yes, I think the coming of quantum mechanics was a big deal, but not as big as ridding ourselves of geocentrism, and not as big as the shift taking place now.)

Still, it's never safe to try to predict a paradigm shift. It's much safer to look back after you've seen how everything shook out and proclaim that a paradigm shift happened. But the year 2000 is a wonderful transmillennial time with people actually arguing whether or not it's the last year of the twentieth century or the first year of the twenty-first. Well, with even something as straightforward to figure out as that in doubt these days, this looks like the perfect time to make claims for posterity. Hence, I say today that we're in the midst of a huge paradigm shift.

But that's not much fun unless I go ahead and make some predictions about what things will look like after the paradigm shift is over. So here they come, five predictions about science (and science fiction) things that will be accepted wisdom by, say, the middle of the twenty-first century. Ready? 1) Faster-than-light travel will not only be recognized as possible, but recognized as feasible and within reach of twenty-first century science (if anyone wants to spend the money to do it). 2) It will be widely accepted that the Big Bang never happened. 3) Gravity will be understood and controllable. 4) Free energy will be widely available to those who can afford it. 5) It will be recognized that time travel into the past will forever be impossible.

Not a bad list, eh? Three out of those five will be pretty cool. Too bad about time travel, but that's the price we'll have to pay for having FTL. Of course, with no Big Bang and thus, a Universe infinite in extent, it shouldn't be too hard to find some place in space where the conditions of the past are exactly duplicated (they used to do it on the old *Star Trek* all the time).

So now I suppose those of you who haven't thrown the magazine across the room already would like for me to explain my predictions?

OK, here we go.

First, FTL travel. I told you a few columns back that I've become an aether theorist, and in particular, a perfect-fluid-model aether theorist. In that fraction of aether models that I subscribe to, the speed of light is a property of the aether, a propagation velocity *through* that aether. The reason that matter behaves as it does near lightspeed (that is, why we get relativistic effects) is because matter itself is made up of structures in the aether, and when the velocity of those structures gets close to the propagation velocity, funny stuff happens. But that doesn't mean there is any limiting speed on how fast aether can move through itself. After all, the speed of sound in a supersonic airplane is much faster than the speed of sound as measured by an observer on the ground, but we don't all go around getting philosophical about *that.*

Second, no Big Bang. By this one I mean that there won't be any Big Bang recognized as the start of everything, the thing that lesser theologians like to associate with "In the beginning . . ." It is entirely possible, and perhaps even likely, that smaller big bangs will be understood to be a relatively common occurrence in a universe of infinite extent. My reasons for wanting to chuck the Big Bang are extensive, but I'll give just two here. I've felt the entire of idea of Cosmic Inflation was a laugher from the start. And as we look out into the Universe with better and better eyes, we see more and more large-scale structure which gets harder and harder to explain as the gravity-modified relic of an explosion.

Speaking of gravity, this brings us to my third prediction, the understanding and the control of gravity. I wish I could point to some specific theoretical work or some specific experiment to tell you why I'm so optimistic on this point, but I can't. Still, my hope again comes from my aether theory views. A properly constructed aether theory will mandate a change in the accepted laws of electromagnetism. Einstein failed to unify gravity and electromagnetism perhaps because he was trying to unify an incorrect theory with a correct one (or another incorrect one). Once the rest of the scientific world comes around to accepting an aether (or at minimum, that the mathematics of that aether hold), then perhaps the unification of gravity with the other three forces (a current "unification" that also will have to undergo modification) will commence. Bear in mind that we've already done a tremendous amount of experimentation. Paradigm shifts are rapid not because a lot of new experiments get performed but because the ones already completed can suddenly be interpreted in a better way.

One other thing on gravity—I doubt gravity machines will be cheap. After all, gravity is lots of orders of magnitude weaker than electromagnetism. If gravity is just a different sort of distortion in the aether, then it is still a weak one, and amplifying weak effects can be expensive.

Fourth on the list is the prediction of free energy. Notice that I didn't say free for all, but free for those who can afford it. As it is, we already do have free energy. Anyone who can afford a sufficient number of solar cells, or his own hydroelectric plant, or even his own geothermal system can go off the power grid. It's a matter of money and compromise. But what I'm talking about is the sort of free energy whereby you buy your energy system from a dealer like you now buy a new furnace, and that's it. It's charged with deuterium, or fairy dust for that matter, and out comes all the electricity you need to run your house for the rest of your life.

Since coming to work at *Infinite Energy* magazine, I've been exposed to an awful lot of new and different "free energy" technologies. None of them are yet ready for K-mart (but then, neither is hot fusion, nor most of the energy systems I read about in *Popular Science* back in the seventies). But enough of those budding technologies have demonstrated that there is energy available from somewhere unexpected that I'm comfortable predicting that it will be ours for an acceptable price.

Fifth on the list is my prediction that time travel will not happen by then and will, in fact, be widely believed to be an entirely fictional concept. I'm not at all happy about that—I'd love to be able to go back in time. So why the pessimism on that score even as mainstream physicists discuss wormholes and time travel machines and whatnot? Well, I don't believe in time.

Can you go outside and point in the direction of yesterday? Of course not. That time can be treated as a fourth dimension mathematically is not to be confused, though it often is, with time being the sort of dimension one can drive his car along. How we measure time is by comparison with some standard timekeeping piece, or "clock." Now, this clock can be anything you want it to be—your pulse rate, and actual wall clock, atomic vibrations, and even the number of times your kid needs a diaper change (seven changes equals one day). But if you recognize that the thing you're measuring is simply a change in an aether flow pattern, and that what you're using to measure that change is, itself, a change in an aether flow pattern, then it comes as no surprise that time as some kind of separate "real" dimension ceases to be necessary.

That's my five. I could give a lot more but I think this should suffice for now. In the July/August 1999 *Analog*, this column's alternate author discussed "What We Don't Understand" in physics and astronomy. I'm fairly sure an adequate aether theory will take care of the explanations for at least five of John Cramer's seven (1,2, 5, 6, and 7).

What new problems will crop up in physics I don't know. I am a bit concerned about my prediction involving time, though. I know enough people first-hand who have, apparently, seen the future in either dreams or premonitions, to give me pause. Among these people is the scientist who convinced me there is no time (it bothers him, too). There also are anecdotal accounts of the past coming forward to intersect the present, but this is fodder for a future column. Still, if I'm wrong about time that's OK. No one is ever entirely correct about everything. In that respect, the twenty-first century will be just like all of those that came before. ■

Cryptic Crossword Answers (from page 108)

1 S	T	2 A	R	3 S	H	4 I	P	5 T	R	6 O	O	7 P	E	8 R
A	■	M	■	M	■	N	■	I	■	V	■	H	■	A
9 T	A	M	P	A	■	10 D	I	S	11 M	A	12 Y	I	N	G
U	■	O	■	13 R	U	E	■	■	O	■	A	■	■	O
14 R	U	N	■	T	■	E	■	15 S	N	O	W	16 M	A	N
D	■	I	■	■	17 A	D	D	■	A	■	■	O	■	■
18 A	N	A	19 L	O	G	■	■	20 J	U	P	21 I	T	E	22 R
Y	■	■	E	■	L	■	■	■	R	■	R	■	■	H
23 S	A	24 T	A	N	I	C	■	■	25 A	C	A	26 C	I	A
■	■	O	■	■	T	■	27 S	28 O	L	■	■	O	■	P
29 M	A	M	30 M	O	T	H	■	T	■	31 R	■	32 P	U	S
A	■	■	U	■	E	■	■	33 T	E	E	■	I	■	O
34 I	N	35 A	M	36 O	R	37 A	T	A	■	38 S	A	L	A	D
Z	■	P	■	C	■	D	■	W	■	I	■	O	■	I
39 E	L	E	C	T	R	O	M	A	G	N	E	T	I	C

Across

1. STARSHIP TROOPER: restyled (anagram of) PROPRIETORS HATS.
9. TAMPA: Florida city, in BanTAM PAperback.
10. DISMAYING: causing disappointment. Construction (anag.) from DINGY SIAM.
13. RUE: to regret; also French for street, a way.
14. RUN: to manage, e.g., a business; also a sequence, as in "a run of spades."
15. SNOWMAN: "Frosty," from the song, made of (snow) FLAKES.
17. ADD: to total; also A DD, standard abbreviation for Doctor of Divinity.
18. ANALOG: magazine in which this puzzle is; also continuously changing variable, as opposed to digital.
20. JUPITER: a planet, i.e., wanderer, naturally found among its own moons.
23. SATANIC: devilish. Resulting from confused (anag. of) SANTA with I (one) C (Roman 100).
25. ACACIA: a shrub, given by letters of CAUCASIAN minus SUN.
27. SOL: the Sun, formed from L (Roman fifty), and chem. symbols S (sulfur), O (Oxygen).
29. MAMMOTH: huge; also a beast.
32. PUS: Nasty matter. Obtained from PUSS without S, i.e., detailed.
33. TEE: First letter (beginning) of TIME; found on (golf) course.
34. INAMORATA: a beloved, from MARTIAN confused (anag.) with O, love (in tennis).
38. SALAD: DALLAS backward (returning) with no-el.
39. ELECTROMAGNETIC: kind of charge, of the kind (brigade) that propagates energy as light radiation.

Down

1. SATURDAYS: Days (times) which have SATURN (a god) endless (without N).
2. AMMONIA: pungent gas, given from MANIA breaking out (anag.) around MO (Missouri).
3. SMART: mentally sharp; also to sting.
4. INDEED: so true, given by reforming (anag. of) DENIED.
5. 'TIS: A contraction that says "It is" differently.
6. OVA: eggs; OVAL, loose term for elliptical, without L (endless).
7. PHI: Greek character, included in all biograPHIes.
8. RAG ON: Continue teasing, from DRAGON without D (headless).
11. MONAURAL: Single-direction sound system, from MON (Scottish pronunciation of "man") and LAURA.
12. YAW: deviate from course, e.g., ship or airplane, appears back(ward) in NorWAY.
16. MOT: French for "word"; TOM (cat) written up.
17. AGLITTER: sparkling; also Ag (chem. symbol for silver) plus LITTER (scatter).
19. LEA: poetically a meadow, set in LEAfy.
21. IRA: Irish REPUBLICAN Army, involved in pIRAcy.
22. RHAPSODIC: ecstatic. Arrangement (anag.) of PA and ORCHIDS.
24. TOM: T (see 33 Across), plus O, plus M (Roman 1,000). With TOM (16 Down written up) makes Tom-tom, a drum.
26. COPILOT: COOL TIP changed (anag.); sits right of the pilot (captain).
28. OTTAWA: in Canada, sounds like (heard) OTTER (aquatic mammal) with WA (Washington state).
29. MAIZE: corn originated by Indians, given by I inside (entering) MAZE (labyrinth).
30. MUM: silent. U, initial (head) of Union, between (among) M and M (Roman 1000s).
31. RESIN: Re-sin, offend again. Sticky stuff.
35. APE: mimic. EPA, Environmental Protection Agency upside down.
36. OCT: diminutive form of (little) October, TO rising (written upward) about C (Roman 100).
37. ADO: from Shakespeare play.

JEFFERY D. KOOISTRA

The Oedipal Concord

Laurence M. Janifer

Finding a suitable occupation can be quite challenging—especially with a resumé like this!

Dear Stan:

Thanks for asking, but no, I haven't found out who Charles Freidrich Main was, or is—absolutely all I know about him is that he's he man for whom the Main (and only) Building of the Local University of New York is named. I do have some chance of digging up more, and you'll be absolutely the first to know—as always, ust between the two of us; the Local University is very shy of publicity, as you know. They're a wholly private universiy, taking no government money of any kind (how many kinds of government money can *you* name?), for instance—earing (and I think with a good deal of ustification) that if they did take some, he government would be at the Main Building front door in about twenty mintes with a list of demands. And any uch list would change LUNY very greaty; I mean, what other university can ou think of that uses Danny Kaye's *The Court Jester* as a basic text for dance lasses, or *Dracula* as material for an thics course?

LUNY is developing a small reputaon all its own, despite the quiet on which it insists—word seems to be getng around, somehow—and it's one I've grown to know a little about after my experience with their Rehab floor. (I'm much better now, thanks—my old wheelchair, just by the way, turns out to be the Hell of a comfortable desk chair, once I don't *have* to be in it.) It's a reputation you really ought to be familiar with. You commuters will never know New York, not well, but you can at least wave at the place from a distance, and LUNY is a fair sample of what does go on here that only the locals know about—along with Little North Evans Boulevard (I'm really going to have to tell you about that one some time, though it has nothing to do with LUNY, or in fact with anything remotely sensible), or the only visible sign of Manhattan's underground river—go down to 1 Fifth Avenue, an expensive-type apartment building a block or two above the Washington Arch (just maybe the only famous monument in the country to have been built—twice—entirely through private subscriptions from citizens), and look at the fountain in the lobby. There's an underground river southwest of that fountain, running under Washington Square Park, and the fountain is its uptown outlet.

You might think that most of the real

oddities at LUNY (to leave the oddities of that river for some other time, I'm afraid) would have to do with their new and very strangely powerful computer (the one Daisy is an interactive array for, if you remember Daisy)—but it's much more a generally odd sort of place. Last time I was up there, for instance, I fell into conversation in the cafeteria with a youngish sort of Assistant Professor who gave his name as Arf.

I didn't catch that right away, and we wandered through quite a series, from Alf to Worf, before he spelled it out for me. It really is Arf, as in Little Orphan Annie's dog's dialogue, and just to get the obvious mistake out of the way, his full name isn't Alfred Robert Fremont or anything like that. His full name is Henri Harfleur Higgins (his French mother was much taken with Olivier's *Henry V,* and his father, a greengrocer from somewhere vaguely Cockney, had no objections). After seeing *My Life as a Dog* some few years back, Arf decided to be known by a shortened version of his middle name. He says it promotes a helpful identification with the students, many of whom do indeed seem very friendly with him, if I can judge by the mound of dog-biscuits he accumulated from young passers-by as we were chatting that first afternoon.

He's in the Department of Psychiatric Medicine, by the way; he teaches three days a week, and has his own psychiatric practice out in Staten Island, where his specialty is acculturation—he does a lot of work out there among Democrats. But that's all to one side; it's the story he told me that I want to pass on—and, once again, just between the two of us. There are some things here that the human race just isn't ready for yet.

I find this one a lot harder to believe than other LUNY stories—but then, the others were built on hard science. Psychiatry is just barely a science, if that; it's a witch-doctor world they've cobbled together, full of interpretations that stand up just as if they were solid objects instead of metaphors—and I am not at all sure I want to associate myself with the sort of conclusions Arf has been reaching. For one thing . . .

But let's not get ahead of ourselves here. Let this tale begin with the discovery of Arf's patient.

After that ancient fellow—you recall?—was discovered in the Alpine ice over near Germany, and people began digging around here and there looking for more quick-frozen prehistory, LUNY sent a small expedition out on much the same sort of quest. In, to be sure, a particular manner I've come to think of as quintessentially LUNY: instead of heading for the Alps or the Urals or even, say, Antarctica, the LUNY expedition headed for a more or less handy collection of North Polar icebergs.

A good try at some of those, they felt, seemed sensible, because the bergs were so much smaller; a search could be accomplished quickly and fairly cheaply, and as the bergs are often headed more or less due south, transportation expenses might be noticeably lower on the return trip. For a university interested in doing the job, but also in saving some money, the icebergs seemed the natural way to go.

And they did find something, if not an ancient fellow; this particular corpsicle, if Larry Niven will allow the borrowing, was only about a hundred and twenty years old, give or take, and didn't seem to be much more shrunken up than someone who'd fallen into icy water and been quick-frozen there for three days or so. This seemed odd, but of course oddities were what the expedition was looking for in the first place, so nobody was unduly disturbed.

The expedition (an Archaeology Professor named Beren, two graduate students, a Professor of Low-Temperature Physics, for some damned reason, and a janitor for the heavy work) and thei frozen little oddity rode the corpsicle' berg part of the way back, made con ections from berg to barge courtesy UNY, porting the corpsicle along in a hunk of Arctic ice, and got back to ew York just in time for the Hell of a ad winter—the one that frostbit all the xpedition members who'd been lucki-r up north, as well as uncounted thou-ands of New Yorkers of all shapes and izes.

And they brought their frozen section o a basement room in Main Building. Vhat you have to picture here is some-hing out of *Who Goes There?*—John ampbell's original story, I mean, hough it's a visual moment we're after. here's the basement room, lit by one verhanging, gently swinging bulb . . . he dozing fellow on duty (the janitor, appy to be back in civilization, until he damn snow started) . . . the Thing it-elf, covered with a tarp, gently dripping s the enveloping ice melts . . . you night as well add mood music, because ohn's writing sure had it. Say something rom Danny Elfman's music for *Batman eturns*, nice and somber, leaning on he bass clef the way he does in every lamned score.

Hold the shot for a few seconds, and hen track in toward the tarp-covered ce block. Everything is sort of dim and nysterious in the swinging light, but we hink we see an arm fall free of the ice. nd we think we see it move . . . pur-osefully.

Music to a sting and out.

No, the janitor doesn't die horribly in nis one. *Nobody* dies horribly in this ne, because we're not in a horror story, e're in real life, where people die nuch less dramatically; you can't just ie, as Richard McKenna noticed, you've ot to do it by the book.

And the book, right here, shows us ne Thing Itself, slowly beginning to nove, to struggle out of Its ice-and-tarp all, sitting up and blinking slowly, ainfully, as It looks around. And we night as well call It an It, because Its ame is Monster.

This is not overwriting, Stan; Its name really *is* Monster. What the LUNY expedition had fished out of a wandering berg somewhere in the Arctic reaches was as near as real life is ever going to get to Dr. Frankenstein's creation—the original Monster.

The Monster—Mary Shelley's original one, not Boris Karloff—was after all last seen riding north on such a berg, giving long speeches about what was wrong with the world and how it could easily be fixed if people were only a little bit different. (Incidentally, it's interesting that naming oddities run right through all this: Arf is Henri Harfleur Higgins, the Monster is not named Frankenstein, and Boris Karloff was not named Boris Karloff; he was William Henry Pratt.) Mary Shelley (whom the feminists, I suppose, will insist on calling Mary Wollstonecraft) lost track of him right there, sailing away on what, if you're a romantic sort, you might think of as the very same berg the LUNY expedition found, a hundred and twenty years later, and he seemed to have died an Inuit death, stranded on the ice like one of their elders and left to freeze while starving. Whatever techniques Dr. Frankenstein (yes, there was one, but hold on for a few minutes before you object; it's a disappointing sort of fact) really did use to bring his spare-part collection to life (Ms. Shelley, for that matter, was never very clear on this in the damned novel, Stan—if you'd been editing her stuff you'd have written irritated letters asking for details, not to mention charts), they seem to have had a lot of residual power; life as a corpsicle hadn't done much to the Monster except provide him with a nice long time-out.

He wasn't quite himself at first, of course—whoever "himself" was. He was sort of slow and clunky, a good deal more like the Monster the movies have got us used to than Dr. Frankenstein's original idealist as reported by Ms. Shelley. The janitor, naturally enough, was scared right out of his wits when It sat the Hell up, and he did an excellent imitation, for a Slovenian, of the classic "Feet, start movin'," but by the time he'd made it out of the room and twenty feet or so down the basement hallway, it dawned on him that nothing, in fact, was following him, and he found a building intercom in a storage room full of maps of Czechoslovakia nobody had gotten around to throwing out.

It was mid-evening up there outside the windows, but Dr. Beren was still in his office in Archaeology, correcting some student papers on shovel and sieve selection. He stacked the papers neatly and rushed on down. (Archaeologists do tend to stack everything neatly, Stan, in case something happens and the stack isn't seen again for seven thousand years.) He and the janitor found the Monster sitting in the janitor's chair—an easy chair somebody had thrown away during the Coolidge administration, which LUNY had picked up in a fire sale many years later—with Its eyes closed. It was sitting some distance away from the big table with its tarp-covered ice bits, humming (Beren remembers) a gavotte from the *Water Music,* and It appeared to be thinking.

When Beren and the janitor came cautiously into the room, the Monster looked up at them. One eye was a brilliant blue, the other a muddy sort of dark brown. Those eyes blinked, and It said: "Where am I?" in a rusty sort of tenor voice.

"You are being helped," Beren said, in as friendly a voice as he knew how to produce. "We only want to help you. What is your name?"

The Monster shrugged—a very odd sight, since the motions of Its shoulders didn't come close to matching. "I have never had one," It said. "It was not thought necessary—they were all in reduced circumstances by the time of their success." By the end of this speech, the rust was flaking away a bit, leaving a fine tenor voice, almost a compelling voice—just a little like Tony Bennett's speaking voice, Stan, though hair less "commercial."

Beren said: "You have been in an accident, in the Arctic. Since that accident some time has passed." He sounded a little stilted, even to himself, and it began to occur to him that he was not the righ person to conduct this interview.

"What has happened to me has been no accident, I assure you," the Monster said. "I died by my own election, Sir."

Beren nodded, just as if he knew wha It was talking about. "We'll be most interested to hear your story," he said.

It came to him that he sounded even more stilted. Luckily, he told himself, he knew who the right person to conduc an interview with this stranger would be—

And that's how Arf entered the picture.

It took him a couple of careful hour to dig out the Monster's history, and o course he didn't believe a word of it. Dr Frankenstein had never existed, after all and the Monster had been a fictional creation of one Mary W. Shelley, who had put more bad speeches into his mouth than your average soap-opera hero eve gets to see.

Real? Don't be silly.

Unfortunately, there was the Monster and even the most slipshod physica turned up oddities his story explained and nothing else did (his hands didn' match, and one forearm didn't match the rest of the arm or the hand it was attached to—just as one example out of hundred). There was also the defrosting process—whether or not deep-freezing human beings works, and you know some of the fights I've had on that subject, Stan, it doesn't work like that.

There was always (Arf had read som science fiction) the alternate-univers theory, which is rapidly becoming th Butler Did It of speculative fiction. But the truth turned out to be much simple and the Hell of a lot stranger.

It seems a Dr. Dedans, a young physician living in Budapest, had read *Frankenstein* in a Hungarian translation, and had been inspired. Of course the thing was nonsense (and the speeches, I am reliably told, are even worse in Hungarian)—but maybe he could make the nonsense into sense, somehow or other.

This was about 1870, and Dr. Dedans worked on electrical transmission in nerve fibers—doing an immense amount of discovery and invention just by the way; the man is as unknown to science as I am, or Arf presently is, and it's unfair; maybe *Analog* should do a piece on him—he worked on nerve fibers for twelve years before he began to see daylight at that end of his search.

Sheer physical regrowth seemed a solvable problem—most human material does regenerate, brain cells and most nerve fibers being the chief exceptions. Growing Hans' arm on Fritz' shoulder presented a whole new set of difficulties, to be sure, but Dedans was equal to some of them, and an even younger man, a Dr. Hrdlicka, had been inspired by the Frankenstein-inspired Dedans, and turned out to be a wonder at what we now know as rejection theory.

(Hrdlicka, in fact, was so thoroughly under the spell of this whole notion that he had his name changed, legally, to Frankenstein. This strikes me as even stranger behavior from a scientist than Newton's numerology, or poor Galois' duelling.)

The notion Dedans started with was that the body parts had to be fresh—getting the dead to live was a neat enough trick, without trying to get the *decomposing* dead to live—and this led to some fascinating plans and performances. Refrigeration might keep all sorts of things fresh, and iceboxes, if not refrigerators, existed—and Dedans used as much of that technology as he could—with only fair success. Getting the parts within an hour or so of the death of the person they'd belonged to seemed a better option but was, understandably, a little tough to manage.

But he managed it. He made arrangements with hangmen and medical men, grown children of aged and sickly parents, and friends and relatives of the local accident-prone. He collected his parts, and he built his body. This may strike you as impossible, in the light of what we now know—but then, you have to remember that, back in those days in the middle of Hungary, they didn't know those things. It was, given the time and place, and the passions of Dedans and Hrdlicka/Frankenstein, not only possible but actual. Carefully following the directions in the book (as far as there were any)—and writing their own, and much solider, book when there weren't—and adding several nerve-fiber wrinkles of Dedans' own development, they brought to life a shambling, somewhat slow sort of Monster.

They decided to show him off, of course—to the Swedish Academy of Sciences, which was then an even bigger thing than it is today. The job of traveling from Buda (they were located on that side of the river) to Stockholm seemed to Dedans an even tougher feat than bringing a collection of spare body parts to renewed life. But they got to Stockholm, complete with Monster and a large valise stuffed with research notes, and they were most cordially disbelieved.

Part of the problem was that Dedans et Cie spoke no Swedish, and the Swedish Academy, though learned, was not learned in Hungarian. The Monster turned out to have a gift for languages, possibly inherited from the previous user of most of its brain tissue, a pickpocket who had once managed the Grand Tour and who, by reputation, spoke about fifteen languages until he was put to death by an executioner friendly to Dedans; and this was some help. But it wasn't anything like help enough.

The Monster was ridiculed as a peasant who'd been in some sort of odd accident, and the research notes were kindly labeled as forged and fanciful. This did not sit well with Dedans et Cie, and even the Monster was a bit miffed, in his slow way. The little company did the only thing that occurred to it: it repaired en masse to a linked series of local taverns.

After the first several drinks, apparently, Dedans started allowing the Monster a slug or six of aquavit—until then it had been drinking straight water, no chaser—and in a comparatively short while our three friends were too drunk to see, let alone think.

Somewhere in there, Dedans and Hrdlicka/Frankenstein lost the Monster. He'd gone off to the Little Boy's Room, and either he'd gone out a back way or they'd simply missed him shambling back and going out the front.

They never saw him again, and what happened to either of them past that moment I don't know, Stan—Hungarian and Swedish records may exist, but I can't get around much in any language but my own, and paying translators to go and hunt up this sort of stuff is, it turns out, frighteningly expensive.

In any case, as it says on the facade of the Library of Congress building, I think it is: What's Past Is Prologue. So much for the Prologue; what my psychological friend Arf was faced with was the end-result—the Monster, back to life and very nearly as verbose.

"I came to a harbor," the Monster said. "For ships, you understand. I spoke a decent French then, some in Hungary could manage it at the time; I was able to sign on to a trading vessel on the Greenland route."

"And so you became a seaman?" Arf said.

"I did not," the Monster said. "Or not for as long as one voyage. But I was familiar with Ms. Shelley's work, and I thought it the proper idea. I was something for which the human race was not yet prepared. I determined to rid humanity of myself, as she had outlined, and deep in the Arctic I threw myself overboard. I remember little more; one does not last a long while in those waters."

And that, Stan, was the burden of his tale, more or less. I have left out a lot, and edited down the Monster just a bit—he did get a bit less Victorian Gothic as he went along and warmed up—but that was what my friend Arf was suddenly faced with: Frankenstein's monster, back to life again and wondering what place the modern world had for him.

It was (Arf told himself), for a psychiatrist, the opportunity of a lifetime.

He gave the Monster every test he could think of, from three varieties of IQ to Draw A Man. The results, he told me, were fascinating: reaction times were slow, in fact heavily subnormal, but IQ tests showed a quick and sharp intelligence, and the various projective tests gave results Arf had never seen before, in any report anywhere.

"Only natural, when you came to think about it," Arf said. "Here was someone who had already died—at least twice, in fact. Once in the Arctic, and once for each body part."

Death, Arf saw, meant never again having to say "I'm sorry," so to speak. The Monster was a man who had worked through all his Oedipal problems, for instance: psychologists tell us that we're all afraid our fathers are going to kill us, for various subconscious reasons, but the Monster no longer had such fears; he'd been there, done that, bought the T-shirt, and hung the plaque on the wall. Whatever he'd used for a death-wish, too, had been nicely satisfied; he was a Fully Integrated Personality.

"But he committed suicide, off a ship in the Arctic," I said at this point. "Fully Integrated Personalities don't—"

"It was a sane act," Arf said. "Mistaken, I feel sure, but sane. Altruistic."

Now, altruism, Stan, is a mythical

state; reports of its existence are always second- or third-hand, and not to be trusted. There are good people in the world—most of them, in fact—but even good motives tend to be personal. Arf, who had been psychoanalyzing policemen and Democrats for a few years, knew this as well as I did—but he insisted that altruism was at the root of the Monster's actions.

"He can afford altruism," he said. "He has no unconscious fears anymore."

"But what is he going to do now?" I said. "Kill himself all over again?"

"We're discussing it," Arf said. "But we may be able to find a place for him in the world. Like any of us, he needs to feel useful."

Well, as an object of scientific research, the Monster would be useful enough—but it didn't sound like an enticing sort of career. I mentioned that, and Arf nodded.

"He must find a way to use his particular talents, and his particular history."

Well, he spoke a lot of languages—but his reaction times were too slow for him to apply for a job as a UN translator, not to mention all the difficulties of getting usable papers. In mystery stories and the like, it's always as easy to get faked and plausible papers as it is to get a pepperoni pizza, if minimally more expensive, but in the real world it doesn't seem to turn out quite that way. I don't happen to know any handy forgers, and Arf knew just as few—and though LUNY might have turned up one or two (teaching classes in handwriting analysis, like as not), Arf didn't want to involve all of LUNY in this situation.

LUNY is a close-mouthed place—but not, perhaps, close-mouthed enough for a story like this one. Someone, Arf was afraid, would get to talking, and the Monster would be standing in the full glare of massive publicity.

"He couldn't stand that," Arf said. "He's still very fragile."

"But fully integrated," I said.

"Glass is a solid object," Arf said. "But it's a very fragile solid object."

So the Monster's place in the modern world would have to be one that wouldn't call too much immediate press attention to his unique history—but would use that history, and his talents. His Fully I. Personality, in fact.

It seemed like a tall order, and Arf went around and around with it for quite a while, he told me. "I thought of making him a therapist," he said. "After all, he *has* worked through his Oedipal problems, his death-wish—he could be very helpful to people who haven't yet done that."

"All of us, in fact," I said.

"Naturally," Arf said. "We haven't died yet. Having been dead seems to be a great advantage, psychologically. But being an analyst—he doesn't have a feel for the terminology, for one thing."

Well, there was always the possibility of a new Hungarian restaurant somewhere in midtown, or just maybe down in the Village. New restaurants have the life cycles of fruit-flies, but the idea seemed worth a try—until Arf found out that the Monster really couldn't cook.

"A shame, in a way," he said. "He's very fond of goulash, and I am myself. We found a decent little cafe in the West 60s, near Lincoln Center—Rakoczy's—and formed the habit of taking dinner there twice a week, while we thought things out."

Weeks, in fact, went by. The Monster was living in the basement of LUNY's Main Building, nicely enough set up, and being supported by Arf. But that couldn't go on forever; Arf's finances were limited, and the Monster was growing restive. The wonders of the modern world were all very well, but he'd never been constructed to be a simple tourist, and he needed something functional to do.

And at last, Arf told me, he found the Monster's niche. Getting him fitted into it required finding him a name, and the Monster, feeling gratitude both to his creators and to his therapist, chose

Frank A. (for Arf) Dedans. It required getting him some false papers, too, but only the easiest kind—a Social Security card. You can get one of those by writing away to the Social Security folks and asking for a new one, under any name at all—which is why cautious folk don't accept those cards as proper identification. But the world, and Frank A. Dedans' chosen bit of it in particular, is full of incautious folk.

He is, in fact, a Nob.

Well, a NOB, to speak strictly—a member of the National Organization for Brotherhood, of which you must have heard. They're dedicated to the notion that people of all kinds ought to be able, somehow, to get along without actually beating one another to death, and they try to advance this ideal by means of establishing a lot of amateur sports teams, a chess team or two, holding neighborhood parties and dances open to all—and by a dizzying variety of lectures and the like.

Dedans is just as dedicated, if not more so: he is, himself, a working tribute to the notion, being built out of a very haphazard collection of people of all races, genders and conditions of servitude. He tells his story at small meetings—they're grooming him for larger ones, as his platform manner improves—and it seems to do some good.

Whether his audiences believe the story, Stan, I just don't know—though no one's called in the media yet, which seems to be what Arf figured on. But even if they take it as a sort of fable, his monstrous earnestness drives the point home—especially to audiences brought up, as everyone is these days, on the *Frankenstein* movies, and TV shows, and knockoffs in other media—I understand one of Glass' disciples is working on an opera about the story, to be called *Pieces of Eight.*

In fact, when I think of the Monster now, it's music that runs through my head—though not Glass, thank God. The last quatrain of Gilbert and Sullivan's *Trial by Jury* provides a fitting finish, I think:

It is patent to the mob
That his being made a NOB
Was effected by a job—
And a good job, too.■

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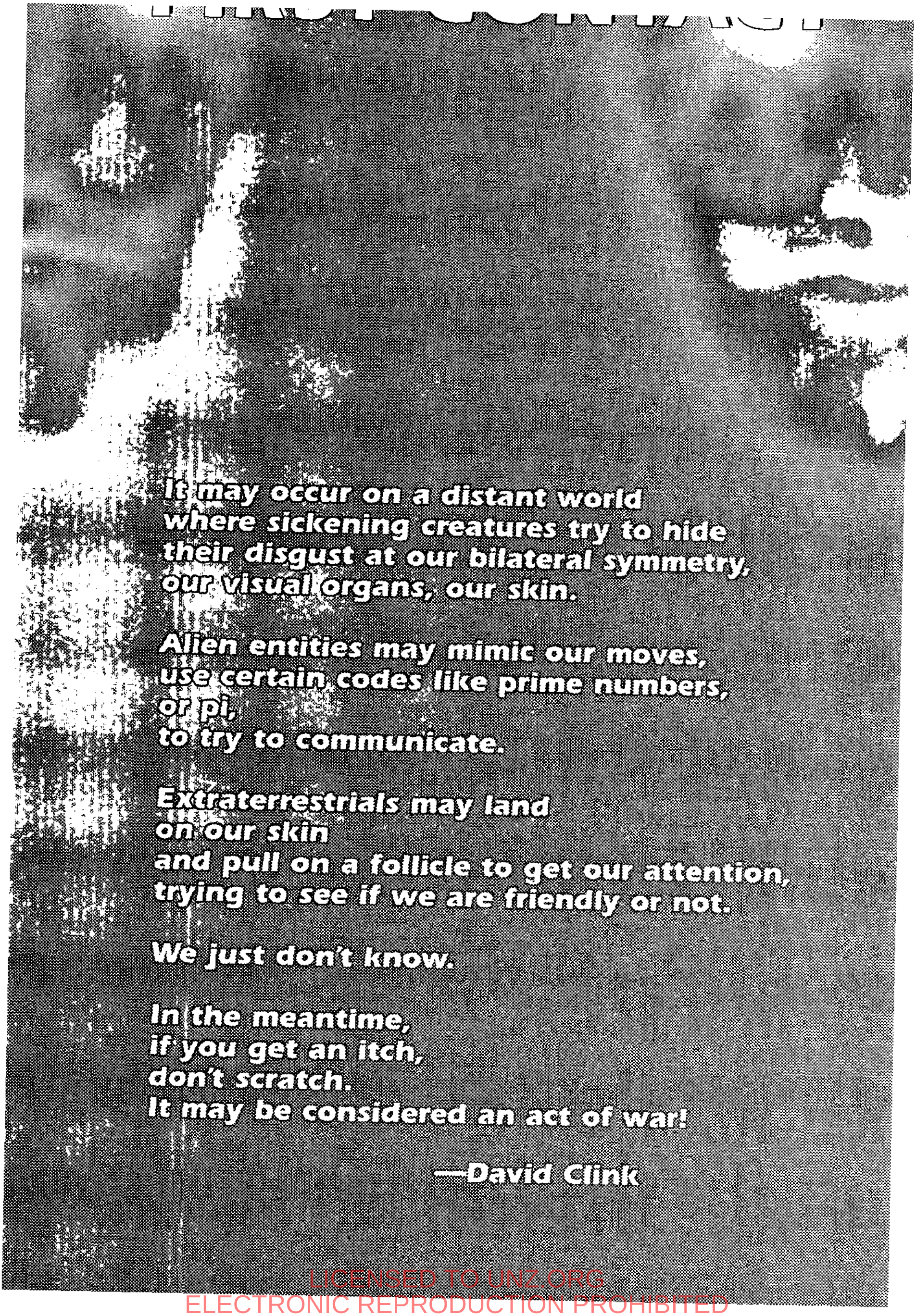


It may occur on a distant world
where sickening creatures try to hide
their disgust at our bilateral symmetry,
our visual organs, our skin.

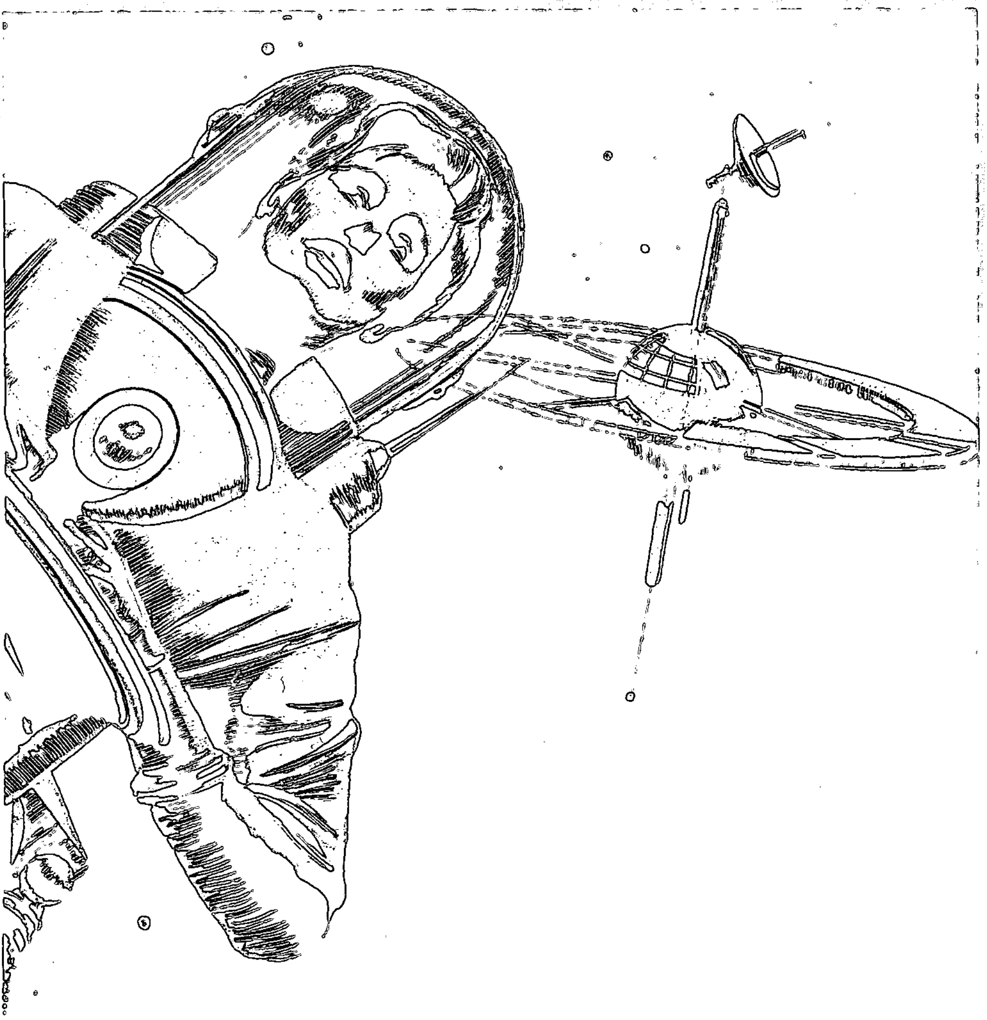
Alien entities may mimic our moves,
use certain codes like prime numbers,
or pi,
to try to communicate.

Extraterrestrials may land
on our skin
and pull on a follicle to get our attention,
trying to see if we are friendly or not.

We just don't know.

In the meantime,
if you get an itch,
don't scratch.
It may be considered an act of war!

—David Clink



The Abyss

James Gunn

Most pilots file a detailed flight plan, but that's hard when you're not sure where you're going!

Illustration by Vincent Di Fate

Shape has no shape, nor will your thinking
shape it;
Space has no confines; and no borders time.
And yet, to think the abyss is to escape it.
—Conrad Aiken, "Sonnet XXVI"[1]

Jessica Buhler looked up from the seam on the cigar-shaped spaceship whose far end, like the horizon, hid what lay beyond. A handheld electronic weld-checker, secured by a safety cord, dangled from the glove of her spacesuit. The ship had been put together from oddly shaped pieces of metal, like a child's puzzle, and the job of checking thousands of seams might never be done. The devices that sealed the seams checked the welds as they were made, but when survival depended on every part and every person functioning perfectly, Adrian believed in checking and rechecking. That was his nature, Jessica knew, but it also was a measure of his commitment to the mission he had chosen. Before she was born, she amended. It was important to keep matters in perspective.

Beneath her was the long hull of the spaceship, apparently complete but as yet untested against the forces of acceleration. Frances Farmstead would have identified the genre as 1930s science fiction. She could tell, she would have said, because the ship looked as if it had been lifted from the cover of *Astounding Stories,* maybe the first installment of *The Skylark of Valeron.* Images that endure, she said, characterize situations better than rational analysis. They encapsulate the wisdom of the species.

Some of the crew laughed at Frances and her genres. "How'd them aliens get hold of a copy of *Astounding?*" they'd say. But Frances was unperturbed. "If you don't identify the situation, you won't know what to do when it comes times to act," she said, and she was so sure of herself that some of them began to wonder if she might be right.

But building the ship hadn't been as easy as the stories made it sound. There was none of this "they all pitched in and by working hard they put the ship together in a few weeks," or "they built the ship in an empty barn by working after school and on weekends."

Jessica was attached to the smooth metal surface by magnetic grapples as she moved, with her machine, from seam to seam. When she raised her head she could see the blue, cloud-strewn globe of the Earth disturbingly above, and then, in a gut-wrenching transformation, like some inescapable abyss yawning below. She closed her eyes and mentally readjusted her relationship to the Universe. It was an exercise in which they all had grown skillful—all except Frances who, in spite of her experience in identifying situations according to the genre models that came to her so readily, had been space-sick until the chemists and physicians found a medicine that worked. Even then Frances had never been able to labor outside where the need to invent one's own orientation had left her dizzy and disturbed.

Past the far end of the ship Jessica could see the skeleton of the old space station, half its parts scavenged for structural elements and hull plates. Like the Kennedy Space Center from which they had boosted into orbit, the space station had been abandoned in place. At first the construction workers who would become the crew had lived in the quarters that once had housed astronauts and experiments. As soon as they had settled in, the station itself, trembling in all its fragile connections, had been raised from its degraded orbit by rocket motors carefully placed to minimize stress. Only afterwards, as people considered the difficulty of constructing the ship that would house the alien-designed equipment and of boosting into orbit the necessary parts, did someone suggest supplementing what had to be manufactured below with materials already available. The first part of the spaceship built, then, was the crew's living quarters. In the alien designs those spaces had been left blank, as if the aliens had understood that creatures who received their message were likely to come in many shapes and sizes. It was an issue frequently discussed over the mess table and in late night bull-sessions: what did it mean that the aliens made no assumptions about the physiology of sentience?

Nobody wept over the deconstruction of the space station except for a few sentimentalists who had pinned their hopes for space on this stepping-stone to the stars. That would once have included Jessica and the head of the project, Adrian Mast, and the ageless Frances, his adviser and coconspirator. But that had been twenty-five years ago, when Adrian had discovered enigmatic drawings in the back of the cult book *Gift from the Stars,* and he and Frances had tracked down its author, the pseudonymous Peter Cavendish, only to discover that he was psychotic.

Even the psychotic can be right upon occasion, however, and the plans themselves, which had first captured Adrian's imagination, had proven themselves legitimate, at least up to the self-replicating devices that drained energy from the Sun and converted it into antimatter in Earth orbit. But the ship itself and its propulsion system remained in doubt, and, above all, the intentions of the aliens. Speculations about the aliens and their motives for transmitting the designs had been the push that had toppled Cavendish over the edge into psychosis. The bureaucrat William Makepeace had warned about the dangers of worldwide chaos and possible war, but Adrian and Frances had released the plans anyway. They trusted the world to use them wisely and people to respond joyously to this gift from the stars, even to this confirmation that aliens were real.

Adrian and Frances thought that the alien designs and the procedures for creating antimatter from the Sun's energy would mean the beginning of the age of interstellar travel, but the world, instead, had seen them as the solution to such terrestrial problems as overpopulation, pollution, and the unequal distribution of resources and wealth. The world was right: they were solutions. With unlimited, almost-free energy, most problems became solvable. But with their problems solved, nobody wanted to go into space. Nobody except a few malcontents. To get rid of them, the Energy Board was persuaded to allocate to the project a quantity of broadcast energy and its equivalent in production. That left the would-be space-travelers dependent upon their own manpower and the construction workers they could recruit. The number of volunteers had surprised them, but all this, and their training, had taken a year, and the construction itself, another four years.

Part of the resources allotted to them was the space station. In another form it might, indeed, reach the stars. If the alien designs worked. That was the immediate concern. What would happen when the button was pushed? Would the containment vessel work or would the ship simply disappear in a titanic union of matter and antimatter? Would the ship disintegrate under acceleration? If it moved, would it move at interstellar speeds? Could they control it? Could their bodies endure it? If everything worked properly, where would they go and how long would the voyage take?

Those were the questions that worried Adrian, even if he didn't show it. They worried Cavendish, who fretted about it all the time until everybody told him to shut up. And it worried Frances most of all, although she concealed it from Adrian and everybody else. She couldn't conceal it from Jessica, however; nothing can be concealed between two women who love the same man, and everything is obscure to the man who is so wrapped up in his job that he has no time for personal relationships.

All this passed through Jessica's mind

in the fleeting moment of relaxation and attitude adjustment before the terrible realization hit her that the ship had begun to tremble beneath her feet.

"What's going on?" she said into the suit radio she had activated with her chin. The receiver only crackled as if someone had leaned against the on-switch. By that time Jessica had slipped the seam-checker into magnetic catches on her suit and was running across the outer hull, breaking one magnetic grapple free and swinging it ahead, and then the other, in an unconscious coordination of movements that she had perfected over the past years. "What's happening?" she asked again. Unfortunately, she was almost as far as she could get from the nearest open hatch. By the time she was halfway there, her body had tightened with the notion that the ship had begun to move. She looked back over her shoulder. It was a movement in the air-tight suit made possible only by her slender athleticism. The skeleton of the space station seemed farther away. It was all subjective, she told herself, and then she was at the hatch and pulling herself into it, locking the hatch door in place with another athletic contortion, and waiting for the air pressure to build to the point where the inner door could be unlocked.

She backed into the clamps that held a row of spacesuits just inside the inner hatchway. It was a slow process, but faster than trying to maneuver down narrow corridors in a bulky suit and then being unable to communicate except by radio. Finally she was free. Dressed in what looked like a one-piece garment of long underwear, she propelled herself down a zero-gravity corridor toward the forward control room. It was like a high-platform dive without an entry, a repetition in which she caught herself with bent knees at a turn and launched herself again until she arrived, at last, at a room crowded with dials and screens and computers and keyboards and distraught people milling aimlessly and weightlessly.

Adrian was among them and Francis and Peter and a dozen or more others whose names and faces had become as familiar to her as neighborhood buddies. Some of them hung upside down or sideways to her orientation, but that surrealistic panorama no longer had the power to surprise. She had no time now to identify them individually. "What's going on?" she asked again.

They looked at her, in every possible configuration. "Someone programmed an engine test into the control-room computer," Adrian said. "Fortunately, there were only a few atoms of antimatter in the containment vessel—maybe a billion or so—left over from the preinstallation tests. And only a similar femtogram of matter. Otherwise it might have been catastrophic."

"We didn't move," Frances said. "Just shuddered."

"Who did it?" Jessica asked.

Frances shrugged.

"No way to know," Adrian said. "We don't even know how it was done."

"But you said a test was programmed into the control-room computer," Jessica said.

"That's the only way the engine could be started," Adrian said. "The entire process is so complex that the human mind can't perform the necessary calculations or react quickly enough. We'll check the computer programs, but I suspect that whoever was clever enough to install the program so that it nestled, unsuspected, among the computer's legitimate programming, won't have left any digital fingerprints."

"At least," Peter said nervously, "we know that the engines work."

"We knew that already," Adrian said. "From the static tests."

"But we didn't know if the mountings would hold or the ship would blow up." A muscle twitched near Peter's left eye.

"We still don't know," Adrian said.

"Some people have said they saw the

bearded man," Frances said.

"The bearded man," Jessica repeated.

The bearded man had become a legend within the crew. Ever since workmen had taken up residence within the space station, one person or another had reported brief glimpses of a strange man. He was described by each of the viewers as wiry in appearance, with skin burnt nearly black by space radiation, against which an unkempt white beard was even more spectacular. The sightings were so fleeting or so isolated that no verification was possible. As difficult as it was to imagine a mysterious person existing within the closed community of space workers, some people were beginning to believe in him; others thought he was a ghost or maybe a mass hallucination brought on by concern about their work and its risks, or the brooding presence of the aliens and all the unanswered questions they trailed behind them.

"We'll put our best people to work analyzing the computer data," Adrian said, "and providing safeguards against future sabotage."

"Sabotage?" Jessica asked. "You think it was sabotage?"

"It certainly seems like it, but we can't let it interfere with our mission or it will have succeeded. Let's get back to finishing up. Tomorrow we load antimatter and reaction mass, and the day after that we take our first test flight. Everything has to be ready by then."

"You haven't said yet who's going to be on board during the test flight," Peter said.

"Everybody who wants to be," Adrian said. "Anyone who doesn't want to share the risks can back out if they wish, with no hard feelings. We'll let them board afterwards."

"And what if it blows up?" Peter asked.

"Then we'll all go with it," Adrian said. "We might as well face reality: This is our only chance. The Energy Board won't give us another. Who wants to survive their dreams?"

Jessica turned from the door into the control room to head back to her lonely job of checking seams. They were airtight, that had been clear ever since the crew moved in, but suddenly it seemed vitally important that they hold up under acceleration.

"Jessie," Frances said, coming after her. "Can we talk?"

As soon as they had reached a point beyond earshot of the others, Frances stopped Jessica with a hand on her arm. "You asked who did it," Frances said. "Some members of the crew think it was you."

Jessica looked at Frances, wondering why the old woman who was her unlikely rival was telling her this. "Why would anyone think that?"

"You were Makepeace's agent," Frances said. "People remember."

"I've worked five years on this project," Jessica said. "How long does it take to earn people's trust?"

Frances gestured as if to say, "People have long memories." And "Look at you—young and shapely and pretty. How can anyone who isn't any of those things be sure what people like you would do?" The movement made her spin gently until Jessica reached out a hand to stop her and relieve Frances's nervous inner ears. Unlike the revealing long underwear most of them wore, Frances was wearing loose coveralls; although biogenetic treatment had removed fat and years, it could not change the fact that she was short and sturdy.

"Anyway," Jessica said, "why would I want to sabotage the ship when I was out checking seams?"

"I didn't say it was reasonable," Frances said. "I just thought you ought to know what people were saying."

"I'm sure they're saying the same thing about everybody, with the possible exception of Adrian," Jessica said. "Nobody's above suspicion, and even Adrian might be trying to test the crew."

"Or get rid of people he doesn't trust by assigning them to duties on the hull," Frances said, "at the time of the test."

"While we're at it," Jessica said, "we might as well throw in the bearded man."

"Him, too."

"Well," Jessica said, spinning toward the distant hatchway, "at least I know you set them straight. About me."

"You know I did," Frances called after her.

But Jessica carried her suspicions back onto the hull and her lonely job. Was it ever going to end? Would she always be an outsider?

At the end of her long shift, tired and hungry and still brooding over Frances's subtle accusation, she straightened up from the last seam and took one final look around. Tomorrow she would be loading antimatter and who knew whether some accident would destroy all their work and hopes and probably them as well. The following day, if all went without disaster, they would make a test run. However matters went, there would not be many more chances to stand free above the abyss and consider her birth planet, a blue, water-blessed oasis in the vast desert of space. She looked at it steadily for several minutes, thinking warm thoughts of home and family and favorite things, before she sighed, secured her equipment to the magnetic catches on the suit, and turned toward the nearest hatch.

Only then did she think about the bearded man and swing around to face the ruins of the space station, looking like the archeological remains of a curiously-shaped dinosaur. On an impulse she moved to a portion of the ship closest to the former station and launched herself into the dark desert she had just been considering. She made a small adjustment of her steering jets and caught a girder on the station as she passed. That sort of space maneuvering had become commonplace in the past four years, although some of the crew were better at it than others and a few, like Frances, never did it at all.

Jessica swung herself along the girder until she reached a portion of the station that still retained a few plates. There she used her magnetic grapples to walk toward the part of the station that was relatively untouched. In the middle of a solid metal wall was a hatch that she didn't remember, that had no business still being there. She cycled it open. Beyond was darkness, and, from the lack of condensation when the hatch opened, airlessness as well. Her suit lights revealed a storeroom in which discarded equipment and tools floated like a Dali nightmare. She shut the door behind her, to keep the debris from cluttering nearby orbit, and made her way through this obstacle course to the far wall where another closed hatch waited to be opened.

She hesitated. Why had no one been here before? Or if they had been here, why had they left the equipment loose behind them and why were the hatches closed? But then, before further doubts could damage her resolve, she reached forward to palm the hatch switch.

The hatch opened. A gush of ice particles rushed past her helmet as moisture from the air within froze instantly. Jessica was glad she had closed the far hatch; the equipment and maybe she herself might have been expelled through the far hatch. The segment of station in which she was standing, it was clear now, had been used as an airlock for the room beyond and the debris, as camouflage. In the next section someone had been living. A net-enclosed sleeping niche was in one corner and in another a closet that might house a toilet and perhaps a shower. A water spigot broke the smooth surface of a far wall next to plastic-fronted cupboards stacked with dehydrated food and quick meals, and a microwave.

The walls themselves were papered with posters and photographs. They were not of Earth but of space and astronomical objects—planets and stars and nebulae and galaxies, and artists' renderings of spaceships making their way among them.

Jessica felt a tap on the shoulder of her suit.

Jessica turned to face a person in another suit—but not the bearded man an overactive imagination had summoned. Features were not easy to discern in the helmet but she could see that the person had no beard. Then she recognized Cavendish. She started to switch on her suit radio, but Cavendish shook his head and motioned her forward. She pulled herself into the segment ahead and turned to see Cavendish follow. He swung himself around at the door and cycled it shut. After a few moments he eased his helmet loose, waited, and then pulled it off. He motioned Jessica to do the same.

Jessica winced at the odor in the room. Someone had been living here for a long time with little sanitation and less concern for cleanliness. Perhaps the waste-disposal system had malfunctioned. The place stank.

"What are you doing here?" she asked.

"I might ask you the same thing," Cavendish said. His left eye twitched.

"Someone's been living here," Jessica said.

"No doubt about that."

"It occurred to me maybe we were overlooking the obvious," Jessica said. "Maybe the sabotage came from the outside. We get so used to being alone up here, we don't consider other possibilities. Maybe those wild stories about the bearded man aren't just wild stories."

"So you came here to check up," Cavendish said. "It doesn't make any sense, though, does it? How could anyone avoid discovery when we were living in this place for a year before we dismantled most of it to build the ship?"

"No, it doesn't make any sense," Jessica said, "but here it is. Someone has been living here. Anyway, that's why I'm here. Why are you here?" She looked at Cavendish suspiciously. She had never fully accepted him and his place among them. She knew he had deciphered the original message that had come to SETI in the form of cosmic rays too energetic to be natural, and that he had smuggled the information out of SETI and published it in the disguise of a UFO cult book; and she knew that his doubts about alien motives had driven him mad, or, rather, had reinforced his natural paranoia to the point of psychosis. But she also knew that, liberated by pharmaceuticals, he had gathered together a crew of space enthusiasts that now made up one-fifth of the ship's crew, and that his efforts had catalyzed the project that led to the Energy Board's decision to allocate resources and let them go.

"I kept looking at the remains of the space station," Cavendish said, "and there was something wrong with it. I didn't know what it was until I began to compare its appearance with videos from the past. And then I realized—"

"What?" Jessica prompted, hoping it wasn't more of his paranoia. But then she remembered how her gaze had been drawn to the station time and again.

"That this part of the station was different. It wasn't here until a few months ago."

"That doesn't make sense," Jessica said. "Does it?"

"It makes more sense than the possibility that someone was living here and nobody noticed."

"Then you think—"

"That this is a space module designed to look like a part of the station, or a part of the station retrofitted to serve as a space module. It could have been an escape vessel in the original plans."

"You think it could have detached itself when we began arriving in orbit," Jessica said.

"And hidden itself god-knows-where. Maybe on the other side of the Earth. Maybe a few hundred kilometers away. We weren't looking for anything or anyone. We thought we were all alone."

"And then," Jessica said, "whoever-it-is decided to come back to see what we were up to. We can check it out. It should be easy enough to discover whether this section has jets and fuel tanks and controls. . . . But why did it return now, just as we are about to fuel the ship and test it?"

"Maybe you've just said why," Cavendish said.

"He—or she—but it must be a he. I can't imagine a woman putting up with this kind of filth," Jessica said. "He must want to stop us from going."

"That would fit in with the sabotage," Cavendish said.

"We've got to tell Adrian," Jessica said.

Cavendish shook his head.

"That's why you didn't want me to use the suit radio," Jessica said, "in case anybody was listening."

"If Adrian decides to postpone the fueling and the test run until we find out why this has happened and who is behind it, the saboteur will have succeeded," Cavendish said.

Jessica looked at him, trying to read his expression. All she could see was his left eye twitching. What he said made sense. It all fit together. And yet it was wrong. "We can't keep this to ourselves," she said. "That wouldn't be fair to Adrian or the crew or the mission."

"I think you're mistaken," Cavendish said. "Nothing must delay our project."

"But we don't know what other sabotage may already have been accomplished," Jessica said. "And we don't know where the person is who occupied this room."

Cavendish looked at the room with sudden surprise. Jessica followed his gaze. Someone had lived here, someone who worshipped space and the stars, a hermit who had brought his cave with him.

"Nothing must delay the project," Cavendish repeated, but this time his tone was different. He was pleading now, his eyes fixed on her as if his existence depended on her answer.

"I don't agree," Jessica said. "But I'll wait until after the fuel is loaded."

Cavendish's eye twitched, and Jessica wondered what she would do in this place isolated from everything and everyone if the unstable personality in front of her should snap. What if he attacked her to prevent her from doing what he clearly thought was against the best interest of the project, or his own? But she showed no signs of her unease. She put on her helmet and as she shoved herself forward, Cavendish moved aside and let her pass.

The antimatter was to be ferried from the nearest orbital converter by a vehicle shaped like an elongated dumbbell, with an engine on one end and a tiny pilot's saddle and controls on the other. In between, empty racks waited for vessels treated as gingerly as eggs and looking something like them—white and tapered toward the ends—or maybe more like oversized footballs for a game between Titans.

Alien devices shaped like giant moths were circling the Sun, soaking up solar radiation, transforming it into high-energy gamma rays by means of alien-designed "magic crystals" constructed of "strange matter," and beaming them back to receivers in synchronous orbit. The receivers produced the antimatter from the gamma rays. One converter had been diverted to storing its output in magnetic containers that Adrian, and a team of theoretical physicists and ingenious engineers, had constructed from the alien designs found in the appendices of Cavendish's book.

Would they work? Well, they—or devices similar to them—worked in orbit to store antimatter until it could be converted into energy beamed down to Earth. But vehicles had to ascend from the spaceship's near-Earth orbit to synchronous orbit, gingerly detach the magnetic vessels and place them with equal care into the clamps prepared for them, and bring them back to the ship's lower orbit. And there the vessels had to be removed and placed in new racks aboard the ship, fastened to devices that would allow them to be tapped, one by one, for their alien contents and fed, a small bunch of ions at a time, into the magnetically shielded engine.

Jessica thought about all these things as she maneuvered the first ferry to dock with the converter. A sleep period had passed since she had discovered the space-hermit's lair. Nights and days had no meaning in orbit, but for convenience most of the workers slept at the same time, with only monitors on duty. Jessica had not slept much, and when she had awakened she had avoided Adrian. It was easy to do in the bustle and suspense of fueling. Her skill in piloting and zero-gravity maneuvers was generally acknowledged, and she had volunteered. The thought that everything depended on her—everything they had dreamed and worked for—made her stomach churn, but the thought of *not* volunteering was even worse. And the thought of what her crew mates would think if she *didn't* volunteer.

The thought she finally settled on was that she would rather be handling the job than leaving it to someone less likely to pull it off without blowing up themselves and the ship and maybe a few hundred thousand acres of home-world accidentally beneath at the moment of explosion. The orbital converter was a maze of receptors and reflectors with an enigmatic spherical structure in the middle. The lethal eggs were racked outside the sphere where they had been deposited automatically once they had been filled with the most destructive substance in the Universe.

She remembered what her mother had told her when she was graduated from college and went out into the world on her own. "I have learned only two things in my life," her mother said, "and it's all I have to pass along to you." And then she said, "Nothing's easy" and "Everything takes twice as long as it's supposed to." Her mother had been right more times than Jessica could remember and now she would have looked at the business of transferring the antimatter containers and nodded. It wasn't easy and she suspected that it would take twice as long as it was supposed to.

As she flipped the switches that held the first magnetic bottle to the converter rack, she thought about Cavendish's aliens. She called them "Cavendish's aliens," because of Peter's book that had started it all. His cult book would have been considered a work of imagination, or psychosis, if anyone considered it at all, but Adrian had stumbled upon it and thought the designs might work. And they had. They had produced antimatter generators and a spaceship that might even prove capable of interstellar travel. And the spaceship might even take them to—what? Adventure? New worlds? The aliens who had sent the designs? Their hearts' desires?

Did Cavendish's aliens really exist, and if they existed would they be generous patrons distributing their largess to rational creatures wherever they existed? Or was there something dangerous, something explosive, at their core? Like the antimatter containers themselves, did they require delicate handling?

One by one Jessica brought the magnetic bottles to the ferry and snapped them gingerly into place until the broomstick was full. Then she maneuvered her cargo out of the converter maze into open space and waited until the spaceship arrived at a point when a slowing of her speed could lower her orbit to a near-Earth rendezvous. There she assisted the unloading and storage of the eggs, fueled the ferry, and headed back to the converter. Not once but three times. Her mother was right. It took twice as long as it was supposed to, but, at last, the eggs were stored, she and the ship and the crew had survived, and the ship was ready for its test voyage.

Except for one thing. The crew. Who would go and who would stay behind?

"Adrian wants to see you," Frances said as soon as Jessica removed her suit.

Adrian waited for her in the tiny conference room located between the living quarters and the control room. It doubled as a mess hall. Everything that wasn't a metal, load-bearing wall was made of light-weight plastic: tables, stools, clamps to hold trays and utensils, and vertical clamps for bottles. The room smelled of meals recently warmed in the microwaves that lined the walls, and over-riding that, of human effluvia that only registered when crew members came in from work outside.

But Cavendish was there, too, strapped onto a stool, looking paranoid and defiant at the same time.

Adrian studied her face. Jessica could feel him trying to gauge her trustworthiness.

"Why didn't you tell me?" he asked.

"What?"

"About the vehicle disguised as living quarters on the old station?"

"Peter argued that I shouldn't tell anyone," Jessica said forthrightly, "that it would only delay the test flight. I didn't like it, but I allowed myself to be persuaded. It looks like that was a mistake."

"Peter says it was the other way, that you tried to persuade him."

"So I see," Jessica said. "If that's what he has told you, then one of us is lying. Either he talked me into not reporting it so that he could report it first and cast doubt on my loyalty to the project, which raises questions about his motivation, or I tried to conceal information that might be critical to its success. Who are you going to believe?"

Adrian steadied himself on the edge of the table to keep from floating away. "A difficult question. Peter has been involved in this project even before Frances and I—"

"And I was a Makepeace agent before I converted," Jessica said. "Maybe Makepeace planted me on the project. On the other hand, I've been a valuable member of the crew, and I've just retrieved and stored three loads of fuel." *And I'm tired as hell,* she could have added, *and my nerves are ready to snap from tension. And you've got me here answering foolish questions.*

Jessica had a foot hooked under a chair and didn't have to steady herself. She shook her head; the movement made her shoulders rotate.

"And Peter has been programming the computer," Adrian said. "It doesn't make any sense," he continued, postponing any decision. That was his major flaw. "There can't be any strangers among us, no bearded men, no ancient astronauts. Why should there be evidence of one?"

"There are stories—" Cavendish began.

"Space legends," Adrian said. "You get a bunch of people together under stress, and stories get started, myths get created and repeated until they lose their origins, people begin to believe in them."

"But the room—" Cavendish said.

"I've checked the computer records," Adrian said. "No astronaut is unaccounted for."

"Records can be doctored," Cavendish said darkly. "NASA wouldn't have wanted it known that they left an astronaut in orbit."

"No way they could have kept it secret," Adrian said.

"Then someone else has been living there," Jessica said.

"Peter said he followed you," Adrian said.

Jessica looked at Peter. Cavendish looked away.

"And he said you seemed to know where you were going."

"I had a hunch," Jessica said. "A sense of wrongness. If you saw it, you'd realize I couldn't live in such a mess. It would have to be someone who can sneak away without being noticed." She thought a moment. "Peter's assignment, programming the computer, leaves him unsupervised. He wouldn't be missed."

"And you've been working alone out on the hull," Adrian reminded.

Jessica shook her head again. "The results of my seam checking are available on the computer. But if the room isn't evidence of a bearded astronaut left behind when the station was abandoned, someone else has been living there. Or it's a set up."

"What do you mean?"

"Maybe it's a puzzle," Jessica said. "Put in place to slow us down. To give someone else time for—"

"What?" Adrian prompted.

"I don't know," Jessica said.

"It's not going to work," Adrian said. "We're going ahead on schedule."

"The test flight?"

Jessica saw Cavendish's body tense. At that moment she understood what was going on, but there was no way to prove it within the time available.

Adrian nodded. "The only decision we have to make is who is going with us."

A sleep-time later the entire crew, all awake at the same period for a change, scattered throughout the ship making last-minute checks of operations and systems that already had been checked many times before. Obsessive-compulsive behavior became normal, as the entire project, and the lives of those aboard, depended upon every part performing perfectly, except for the crew, whose inevitable mistakes had to be anticipated. And there were some alien design functions built into the ship that Adrian and a few others thought they understood, but no one could be certain until the ship moved. That made everybody nervous, particularly Cavendish, who buried himself in computer readouts and simulations.

Finally, however, everything was declared as ready as it was likely to get, and Adrian assembled the crew in the largest of the three dormitories, the one for unmarried men; the two smaller were for unmarried women and for couples. Contemporary mores mixed genders as if ignoring their differences could eliminate them, and the designers of the starship expected growing fraternization. Eventually the largest dormitory might be turned over to the couples. But the designers—mostly Adrian—had decided that a certain amount of privacy, limited though it was by the spaceship volume and its necessary functions, would be a healthy preface.

Even the largest dormitory was crowded by the 212 people who had volunteered to construct the ship. One had been killed, one had been injured so seriously that she could not continue, and one had come down with multiple sclerosis. The conquest of space exacted casualties.

Some of the crew members sat on the edge of bunks, an arm or a leg wrapped around a tubular support. Others anchored themselves to the wall by the hand-holds placed at regular intervals, and others simply floated, at ease in free fall, in mid-air. Jessica was one of them.

Adrian was just inside the oval bulkhead, whose entrance could be sealed automatically in case of meteor strike or other accident. Most of the construction crew could see him, but all could hear. "I don't have to tell you," he said, "that we are prepared to take a momentous step. Our job here is done, and our next challenge lies ahead. Not all of you signed on for that part of the adventure, and those of you who choose not to stay aboard for the test flight may wait in the remains of the old space station.

"I understand," he said, "that a new living facility has been added recently."

Jessica could feel Adrian's glance, but she was looking at Cavendish, clinging to the support of a nearby bunk. Cavendish was looking hard at Adrian as if forcing himself not to betray himself by looking at her. Then Jessica looked away to see Frances studying them both.

Frances knew that Cavendish was avoiding looking at either of them. But Jessica wondered how much Frances knew and whom she believed. Adrian trusted Frances's judgment. Even though Frances reduced everything to familiar scenarios, she had been partnered with Adrian for twenty-five years, and they had brought this whole thing off, just the two of them. So what Frances believed counted.

Jessica thought back to her own beginnings. She had grown up secure and happy in a supportive California family, free to go where she wanted, to surfing or the tennis court or off to college, never doubting that she had a place to return to and people who loved her, no matter what, until the 'quake of '21 hit and her family was in the middle of it. The Energy Board could solve or ameliorate most human problems, but it couldn't control the natural processes of the Earth. Jessica never knew whether her family was killed when their house collapsed or by the tidal wave that washed everything out to sea.

In the aftermath of that catastrophe, the recruiters for the Energy Board had looked like a new family, and she had reached out to them blindly. She had accepted one harmless assignment after another, mere bureaucratic information-gathering, unaware that she had been identified by the agents working for William Makepeace. Even when she received the assignment of pretending an affiliation with a group of space enthusiasts, it seemed like only another way to gather information, and simulating a relationship with a man she had never met, and never heard of, seemed innocent enough. She was part of a family, and family did no wrong.

And then when she met Frances and later Adrian she discovered that life was not so simple. Life demanded choices between options that seemed equally attractive. Nobody knew how choices would turn out, so it was a matter of weighing facts and the logic that connected them. Ultimately, though, it boiled down to temperament: either you were conservative, like Makepeace, valuing what he possessed and what those around him possessed, which formed a seamless wall of covenants, and you were apprehensive of the change that might endanger those possessions; or you were adventurous, willing to try something new even if it cost you everything, enraptured by a dream and pursuing it past the point of pragmatic reality, hitching your wagon, literally, to a star.

That is why she had abandoned the family she knew for the dream she had only barely understood—that and the attraction of the man who owned the dream, or was owned by it, the unprepossessing Adrian Mast whose soul was illuminated by his belief in humanity's future in space.

"So," he was saying, "we will test ourselves and our ship today. Nobody will hold it against anyone who wishes to leave. In fact, we will make it easy. There will be no guard on the exit hatch, and the monitors will be turned off. Those who choose to leave will be given an opportunity to rejoin the ship after the test-run, or they may return to Earth on the next shuttle. Are there any questions?"

Cavendish looked as if he wanted to speak but remained silent.

"All right, then," Adrian said, "the test will begin in two hours. And may good fortune be with us on our maiden voyage."

Jessica looked at Frances and then at Adrian and finally at all the faces with whom she had grown familiar over the past few years. She realized that what she had chosen was a new family, but a family all the same, and the possibilities were great that today she would lose this one, too—and life itself.

The engine started smoothly, almost imperceptibly. Louder than the whisper of the exhaust were the exhalations of breaths within the control room. Jessica hadn't realized until then that waiting for the moment of truth had been like waiting for the dentist's explorer to touch an exposed nerve or reaching the point on the roller coaster ride where it hesitates at its apex before plunging into space. She looked at Adrian, who was strapped into the pedestal chair next to her. He glanced at her and grinned. It was an expression at least as much of relief as joy.

Two other crew members in the control room monitored the engine-room gauges and the remote sensors, but otherwise it was Jessica and Adrian. Frances had complained of a headache and gone to the unmarried women's dormitory to lie down, but Jessica thought it was because she didn't wish to risk being space-sick in front of Adrian when the ship began to move.

Jessica looked at Adrian again. He nodded. She edged the ship out of orbit with the manual controls, careful not to approach the remains of the space station where members of the crew, as yet unspecified, had absented themselves, or to point the ship's exhaust in that direction. The antimatter should be completely annihilated in the magnetic-bottle reaction chamber, but no one knew if the design was perfect or if it had been perfectly translated into metal and strange metal. In the world where matter met antimatter, nothing less than perfection sufficed.

Jessica had not slept well last night. In fact, she did not remember sleeping at all. But now she felt alert, alive, exhilarated, as if she had set out to kill a dragon but had captured it instead and tamed it and rode it, wings flapping, into the sky. The ship that they had put together piece by piece and part by part, that had seemed as if it would never be complete or if complete would ever function as intended, was an entity, by some gestalt magic turned into a living creature. Even the feeling of weight was different, pressing them into their seats, giving reality to what had seemed like airy insubstantiality.

The control room was silent as people concentrated upon their tasks, but a murmur came from the corridor. It was a sound like the well-bred approval of a Wimbledon point well played, and Jessica realized that the crew, at stations throughout the ship, had broken into relieved conversation. "We're off to see the Universe," she said to Adrian.

He nodded and grinned, as if he did not trust himself to speak.

As soon as the ship had cleared near-Earth orbit, Jessica accessed the next preprogrammed maneuver. Their velocity would gradually accelerate until the ship reached an orbit beyond that of the Moon which would be, by that time, on the other side of the Earth.

"I'm going to check on Frances," Jessica said.

"I should have thought of that," Adrian said.

Jessica made her way to the unmarried women's dormitory, adjusting to the realignment of walls and floors under acceleration pressure. She missed the freedom of weightlessness, but that loss was balanced by the exhilaration of motion.

The dormitory was empty.

Jessica felt a flash of hope that Frances had, somehow, slipped away to join those who had absented themselves from this test run but recognized the folly of that thought. Frances could not have left and would not have left, and Jessica did not want her to leave. The competition between them was nothing compared to their friendship.

Jessica found Frances in the unmarried men's dormitory. She was standing in front of an open locker. Frances turned to look at Jessica as she entered. "I thought it was time to check on the absentees," Frances said.

"Adrian said—"

"Leaders can afford to be magnanimous only if they have skeptical lieutenants," Frances said. "We're launched on an adventure, and in every adventure scenario there's a weak character who is going to endanger everybody, and the quest itself."

"I always thought you had me picked for that role."

Frances shook her head. "That was always a possibility, but it's either the one you don't expect or the one you know is going to break, like Conway's brother in *Lost Horizon.* In this case, it was most likely to be someone who wasn't on the test flight."

"And how did you figure out who that was?"

"I turned the monitors back on. Nine people left the ship: Cavendish and eight of the people who were with him from the start, back at the abandoned Kennedy Space Center."

"Why am I not surprised?"

"That was clear after his accusation. The accuser is either unwisely ignored or is trying to shift suspicion from himself."

"Or trying to convince himself that his treachery belongs to someone else," Jessica said.

"That, too. But this pretty much clinches it," Frances said. She pulled an object from the open locker and held it, dangling, from her hand.

Jessica stared at it, trying to decipher what it was. Then it came into focus: it was a latex mask, like a man's skin slipped intact from his head. There was a bald head mottled with spots of age, a tanned and aged face, and a long, white beard. . . .

"The bearded man," she said. "And the locker?"

"Cavendish's," Frances said.

From over the public address speakers Adrian's voice said, "I thought you'd all like to know: I've started the next programmed flight sequence."

Jessica knew what that meant. The ship was launched on a course for Mars. One of the tragedies of manned spaceflight was that the energy behind space exploration had dwindled before humanity had an opportunity to investigate any of the planets, even the nearer ones, and on their maiden test flight Adrian hoped to rekindle the popular imagination with a flyby.

The information about Cavendish may have come too late.

By the time Frances and Jessica reached the control room, plodding along in the traditional step-by-step that pleased Frances and annoyed Jessica, the ship had been accelerating for five minutes at a steady one gravity. The control room wasn't at all like those on the television shows Jessica had grown up with: it was spare and utilitarian, with a semi-circle of pivoting armchairs mounted on pedestals and equipped with Velcro belts. The chairs faced a curved, plastic countertop inset with dials and keyboards. Above that a series of vision screens showed the various working areas of the ship and exterior views in all directions.

No windows. Jessica recalled Adrian chuckling when Peter asked about the plans. "Windows!"

Jessica shook herself before she fell into one of Frances's genre pits. Identifying the genre wouldn't help here.

Adrian swiveled around to face them, pleased with himself and his world. Jessica hated to spoil his mood. She looked at Frances.

"I found this in Peter's locker," Frances said, holding out the mask.

Adrian took in its meaning at a glance. "So," he said, suddenly sober, "Peter is the bearded man. I wonder what he hoped to gain by that. What does he have to say?"

"I don't think we'll ever know," Jessica said.

"He isn't around to ask," Frances added.

"That's a pretty fast search," Adrian said.

Frances shrugged. "He was among those who left." She seemed much more in control now that her trial by weightlessness was over. "You know the way hings work. You propose and I dis- ose."

Adrian accepted Frances's breach of is word without comment. Jessica did- 't know whether it was because he ex- ected it or because they had more seri- us concerns. She hoped it was the last. he didn't want to re-evaluate the rela- ionship between Adrian and Frances vhile she was still struggling with the mplications of Frances's last sentence nd Adrian's failure to react to it.

"That means we may be sitting on a ime bomb," Adrian said.

"Clearly," Frances said.

"I feel sorry for Peter," Adrian said.

"I know."

Jessica looked from one to the other mpatiently. "Why are you talking about oor Peter when there's so much to lone?"

"The question is," Adrian said, what's to be done?"

"The ship is working like a dream," rances said, "but there's no way of nowing when it will turn into a night- are."

Jessica looked from Adrian to Frances nd back again. "What are you saying? ou don't even know what's wrong. ou don't even know if anything is rong." She moved impatiently to the ilot's chair and began looking at the adouts.

"If there's anything wrong," Adrian id, "—and there almost certainly *is* omething wrong—it will be in the omputer. The glitch in the computer rogram two days ago was a test."

"And a warning we should have paid ore attention to," Frances added.

Jessica hated the way Adrian and rances completed each other's oughts, like an old married couple. e typed in the command for the com- uter to switch to manual, but the ship ntinued its acceleration unaltered.

"We all knew how much this project eant to Peter," Adrian said. "It was rd to believe that he would sabotage the only thing that would bring him peace."

"What we didn't know," Frances said, "was how great his fear still was." Adrian shook his head, as if he was trying to clear it of clutter. "He started the whole thing. Without him there would be no alien message, no designs, no project."

"He stood in for humanity itself," Frances said. "Attracted by the mystery; afraid to find the answer. Attraction and repulsion. Balanced in most. Exaggerated in some, like Peter, to the point of anguish. Finally the fear got the better of him."

"We may well be in a difficult situation," Adrian said, "but it's Peter I feel sorry for. He'll never know. He has to know, and yet he never will."

"I hate to say this," Jessica said, "but that's the dumbest thing I've ever heard. Peter has been working for Makepeace. Only Makepeace could have arranged for the capsule that fit so neatly into what was left of the station, and only Makepeace could have come up with the scenario that landed us here. He doesn't want us to succeed. For earthbound humanity's reasons, sure, but most of all for Makepeace's reasons. I've worked for him and I know how he thinks."

Adrian and Frances exchanged glances.

"That may be true," Adrian said, "but it doesn't change anything."

"Well then, try this," Jessica said. "The manual controls don't work."

Adrian nodded. "And I'd guess there's nobody aboard who knows how to reprogram the computer."

Jessica looked at their eyes, first Adrian's and then Frances's. They were curiously unafraid. She realized that they were looking at her eyes, as well, and that in them they would read frustration and impatience and, yes, fear. She turned to the vision screens while she tried to gain control of her emotions. The rear view showed a rapidly retreating Moon, and the one slightly to the side, a disappearing Earth still a fertile blue streaked with white. On the other side, where the Sun would have been, the overload had closed down the receptors. Ahead was the star-strewn blackness of outer space.

She looked at the readouts. "We've been underway for an hour," she said calmly. "Our speed is thirty-five kilometers per second, and we're almost sixty-four thousand kilometers from Earth."

"If the program maintains this acceleration," Adrian said, "by tomorrow we'll be about one-sixth the way to Mars."

Jessica input an inquiry. "Our course and speed have us arriving at Mars orbit two hours before the planet does. Unless something changes, it seems likely that Peter had something else in mind."

"And it seems likely," Frances said, "that if Peter had intended to destroy the ship, it would have exploded by now. Some celestial fireworks would have been a good object lesson for the rest of humanity."

"The question is," Adrian said, "what were Peter's intentions?"

"Jessica," Frances said, "you just got that information from the computer, didn't you?"

"Yes."

"You said it had locked you out."

"I said it wouldn't let me change our acceleration or course, or switch to manual," Jessica said. "Everything else is proceeding normally. It's providing readouts, controlling air composition and temperature, showing us views, everything it was built to do—except letting us choose where we want to go and how fast. Like a virus that's taken over that one part of the computer."

"That means that Peter had some kind of plan."

"Like a one-way ticket to an unknown destination," Adrian said.

"I guess we'll know when we get there," Frances said.

"If he just didn't want to get rid of us with a ticket to nowhere," Jessica said.

Adrian shook his head. "That wasn't Peter's way. He had these twin compulsions of fight and flight. He couldn' bring himself to fight but he couldn' bring himself not to seek the answer his neurosis needed. So he has sent us t find out the answers."

"Which he'll never know," Jessica sai impatiently.

"Which he'll never know," France agreed. "And he'll grow old never knowing. He'll have psychotic episodes whe he wants to kill himself because of guil and others when he thinks he's gettin messages from us or from his aliens He's going to have a miserable existenc and die a miserable death, wishing h were here, but at least he's going t know that we're out there, looking. Frances gestured toward the forward vision screen with its star-sprinkled vastness.

"It could be the aliens themselves, Jessica said. "It could be an alien viru inserted who knows when, intended t bring us to them, like sheep to th slaughter."

"That sounds like Peter's paranoia, Adrian said.

"Or Makepeace's," Frances said.

"On the other hand," Adrian said, "Peter may well have had information tha he was withholding."

"What kind of information?" Jessic asked.

"Information about where to go onc the ship was built."

"Instructions from the aliens?" Jessic asked.

Adrian nodded.

"But why would he withhold it?" Je sica asked.

"Maybe he concealed it even fro himself," Frances said. "Because it w too horrific."

"If it was too horrific for him, wh shouldn't it be horrific for us?" Jessic asked.

"Because he's paranoid," Adrian sai "and we're not."

Jessica turned back to the keyboard the pilot's station. "Maybe you're sati ied to go where Peter's paranoia takes 'ou, but I'm going to learn how to mas- er this computer. I'll break into its pro- ;rams and make it take us where I want o go! After all, we've got all the time in he Universe."

"And where do you want to go?" Adri- n asked.

Jessica was silent for a moment. "I on't know. I just don't want to be—ab- ucted." She swung back around to face em.

"Frances," Adrian said, "I think it's a ood idea to develop the skills to repro- ram the computer. Between Jessie and ie, and whoever else has some talent r it, we ought to be able to figure out ow to do that."

"That's a good idea," Frances said.

"But, Jessie," Adrian said, "once we o regain control, I think we'll have to onsider leaving Peter's programming tact."

"But why—?" Jessica began.

"I think he programmed in the in- ructions about how to get to the iens, the part of the original message e never revealed to anyone. And I think e won't ever find a more suitable goal, d we'll never be satisfied until we find the answers to our questions as well as Peter's."

"Why did they send us the plans?" Frances said. "What do they want from us? Who are they?"

Jessie turned back toward the vision screen that showed the depthless blackness littered with tiny lights that represented the long way ahead. Everything was orientation and a constant adjustment of one's relationship with the Universe. If their acceleration remained constant, the ship would leave the Solar System in thirteen days and in another four hundred days or so they would pass beyond the Oort Cloud.

Behind them, looking at it from the viewpoint of the Universe, would be cosmic debris. Ahead would be the abyss, the bottomless pit of interstellar space.

And even deeper, the mysteries of where they were going and what strangeness waited for them at the end of their voyage.☐

(Editor's Note: This story is a sequel to "The Giftie" [November 1999], and "Pow'r" [January 2000].)

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Probability Zero

Bud Sparhawk

The Emperor's Dark Matters

The Emperor's Hall of Science was imposing. On all sides were scientists from thousands of races, representing millions of worlds and cultures beyond counting.

"The Emperor insists that the humans be allowed into the Hegemony for their wondrous invention," Hoar-tooth, the Academy's Director, snarled to Hopkingsontumdiddle, one of the scientists examining new acquisitions. "Where is this wondrous device that required so many transport ships from Earth to build?" He glared around the empty hall.

"It's right there," Roxanne Boldres said confidently and pointed to the empty area in the center of the Hall.

"If this is some sort of joke . . ." Hoar-tooth growled.

"Not at all," Roxanne explained smoothly. "We built a magnificent machine made entirely of dark matter to demonstrate our theory. For your information, it currently has a mass more than twice that of the entire planet on which we stand."

Hoar-tooth leaned forward and scanned the area with his universal analyzer. "Something that massive has to be detectable yet I can find nothing!"

Roxanne laughed. "That's becaus this machine is made of dark matter th doesn't interact with secular matter. M race has long known that the dark var ety makes up more than half of the tot matter in the universe."

Hoar-tooth wavered. "How come w never discovered such ourselves? Dar matter seems rather improbable."

"Improbable but true," Hopkingso tumdiddle hissed as it inserted itself b tween Hoar-tooth and the human. It w one of two candidates for the Chai "This theory, while impossible for b ings of lesser intellect than myself t grasp, nevertheless appears to have, a substance, if you'll excuse the term. Th device will function as claimed."

Gurgleburst, the phlomb-wave Impe ial, flashed his disagreement. "I dou such backward beings could discov something the universe's assembled g nius did not. I thought we'd long prove that we'd reached the very end of th scientific age. We've reached the limi of knowledge. Little remains except r finements of known facts—simp adding ever more decimal places to lo established measurements. Everythi possible to know is known—anythi else is best left to the theologians."

"That is only because you don't have the intelligence to understand the theory," Hopkingsontumdiddle replied smugly. "That is why you are so undeserving of the Chair."

Gurgleburst radiated anger. "As usual, my esteemed rival has been misled. I found their so-called theory remarkably easy to grasp; indeed, it appears to be merely an extension of some discarded ideas of my own. That is why I must have had an easier time than my esteemed colleague in realizing that it is impossible."

"I did not say that I had difficulty," Gurgleburst exploded. "I merely said . . ."

"Enough of this bickering!" Hoar-tooth rubbed his tusks in thought and turned to Roxanne. "Forget the theory; exactly what function does this invisible, undetectable machine of yours perform?"

"An excellent question, and quite perceptive, if I might say so," Roxanne said smoothly. "In brief, I have created a black hole generator. It is using its immense mass to incorporate ever more dark matter into itself. It will acquire sufficient mass to collapse into a black hole. Then it will have such massive dark gravity that not even radiation can escape. Eventually it will become so massive that it will disappear entirely from this universe!"

Hoar-tooth exploded. "Are you telling me that your *undetectable* machine will create an *imperceivable* black hole that will prevent *invisible* radiation from escaping?"

"Yes."

"*Theoretically* possible," Hopkingsontumdiddle corrected instantly.

"I disagree," Gurgleburst interrupted. "Because of my superior understanding it is clear that this," it waved at the empty space, "cannot possibly have the effect that she claims."

"Idiot!" Hopkingsontumdiddle spit.

"Dupe!" Gurgleburst replied.

At that moment a small furry creature the size of a mouse scurried across the hall and stopped at the center.

It waved its tiny paws in the empty space. "There is nothing there!" the diminutive creature exclaimed. "There is absolutely nothing there!"

"Nothing?" Hoar-tooth spun around and bristled. "I imagine that you have some explanation," he began.

"Yes," Gurgleburst jumped in quickly, "As I said earlier, I doubted that . . ."

But Roxanne and Hopkingsontumdiddle were dancing around in glee. "The device completed its work!" they shouted. "We've proven the theory!" ■

Beware of anyone who demands your allegiance. He obviously fears, probably with good reason, that he can't earn it.

— Kelvin Throop

I have always observed that to succeed in the world one should appear like a fool, but be wise.

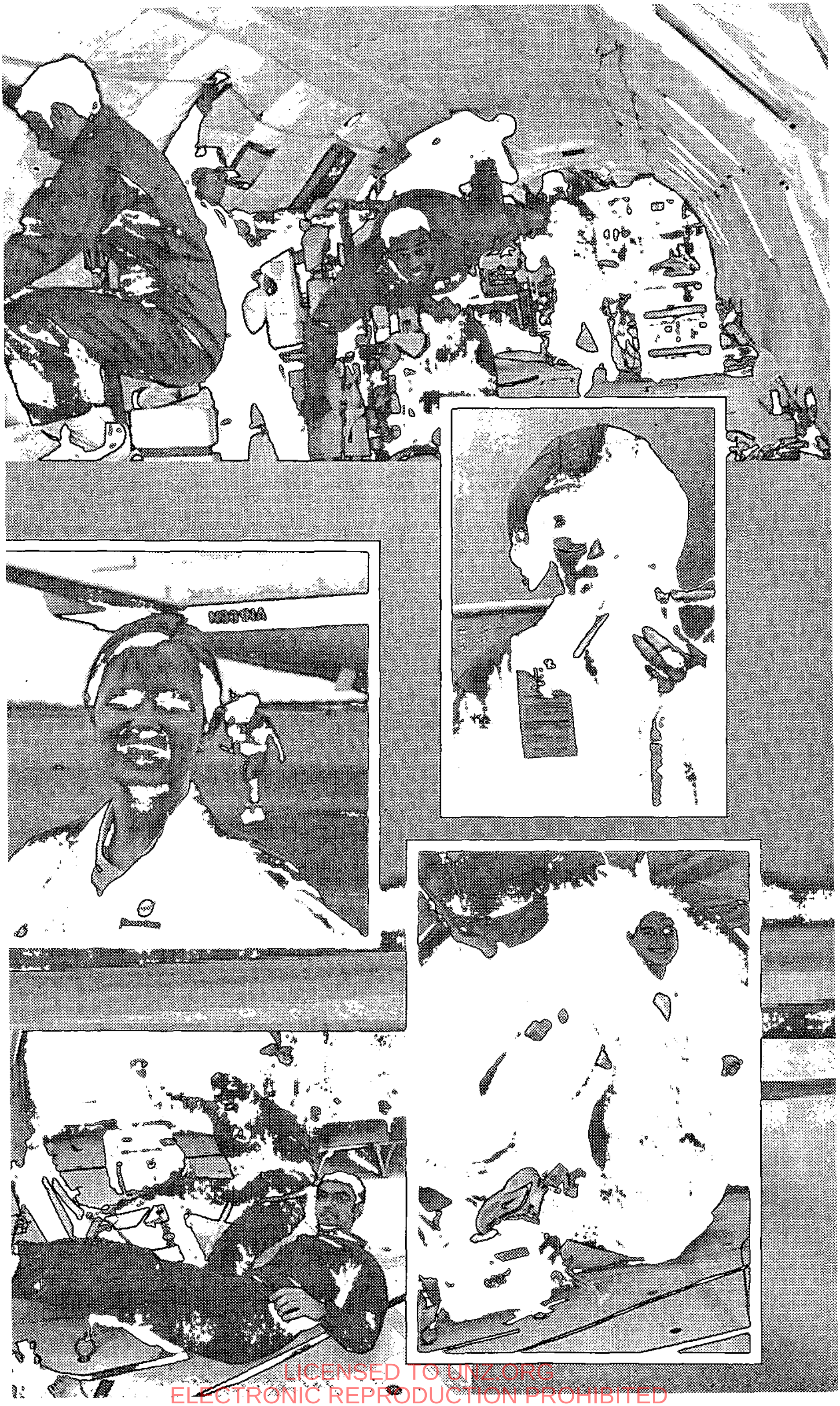
—Montesquieu

Fictional Space Versus the Real World

A Personal Report from NASA's Roller Coaster in Space

Marianne J. Dyson

There's no substitute for personal experience to learn what things are really like—and it's the little things that make the difference!



Part I
Hypoxia and the Right (Brain) Stuff
Training in the Hyperbaric Chamber

As a science fiction reader, I have often role-played a character whose spaceship, because of poor maintenance, sabotage, or accident, is faced with a loss of cabin pressure in space. These heroes, if they have any symptoms at all, report feeling a bit light-headed or experiencing tunnel vision, but somehow always manage to keep their wits about them and save the day. In the spring of 1999, I had a chance to find out for myself if these fictional accounts were realistic, overblown, or understated.

My opportunity came when members of a National Space Society chapter at the University of Illinois—who knew me as an NSS Board member and writer—asked me to be their team journalist for a flight on NASA's KC-135, a.k.a. the "Vomit Comet." The KC-135 is a turbojet that flies to 35,000 feet, then falls 10,000 feet, providing about 25 seconds of weightlessness. Each drop is followed by a pull-up maneuver that creates twice the force of gravity (two gs). Sometimes things go wrong during these roller-coaster flights, and NASA therefore insists that all people who fly on the KC-135 be able to handle emergencies, including a loss of pressure.

First, all participants must pass a modified FAA flight physical. Overweight individuals are disqualified (no chubby heroes) because fatty tissue stores nitrogen which would bubble out during high-altitude decompression and cause the bends. NASA also won't let anyone fly with respiratory problems such as asthma, colds, allergies, or ear infections. Those who pass the physical must then take a daylong physiological training course.

The course explained why drinking and smoking would be especially perilous to our would-be science fiction heroes. Alcohol limits the cells' ability to accept oxygen, and the carbon monoxide in smoke sticks to hemoglobin, reducing the amount of oxygen delivered to those cells. If the brain is short of oxygen, one of the first things to go is the visual system. This explains why tunnel vision is a symptom of hypoxia.

It's true what they say about a little knowledge being a dangerous thing, especially when combined with an active imagination. When NASA put me into their giant Thermos bottle, also known as a hyperbaric chamber, and sealed the door, all the worst-case scenarios ran through my head. This was no story, this was real. They were pumping out the air! My heart raced in fear. Even though I had on an oxygen mask, I felt like I was suffocating. My left brain kept saying "Everything's fine. The test director is right there watching, and the doc is only two feet away. You can handle it." But my right brain kept screaming, "I can't breathe! Take this mask off! Run!"

Luckily, my left brain stayed in contro of my hands and mouth, even if my heart, pounding a mile a minute, rebelled and followed the right. The tes director, a distinguished-looking older man, talking in soothing tones from outside the window to my left, carefully explained that this chamber was completely safe. We had two instructors in there with us, one at each end, and someone stationed at each window There was a yellow emergency oxygen bottle in case of a power failure, but tha had never happened. We did a radio check. Each person answered, "Loud and clear." I was surprised my voice didn't squeak.

Gradually, my heart stepped back from the ledge. Left brain said, "You coward. You don't deserve a chance to try free-fall next week." Right brain said "Be quiet! Can't you see I'm busy Breathe in, one two three, out, one two three . . ."

I was startled out of my counting when we switched to pressurized breathing. It was like sticking your head

ut the car window while going 70
nph—the air is literally forced down
our throat. But that felt kind of like a
ong drink when you're thirsty, very
ice after the suffocating feeling. It was
he breathing *out* that worried me. I had
push the air out, and the mask made
his horrible blubbering sound like a bad
oy running his finger over his lips at 30
ecibels next to my ear. I had never read
bout that in a story.

I became certain my mask was bro-
en, and I would soon drown in all that
ulped oxygen. Too much oxygen can
e as much of a problem as too little—
yperventilating while using an oxygen
ask can lead to muscle spasms, visual
npairment, and hot/cold flashes. I
ushed the talk button and hollered that
ere was a loud sound. The test direc-
r assured me that this was normal. My
ft brain said, "See? Don't worry. It's
ormal." My right brain replied, "This is
OT normal. Nothing about this is nor-
al! Make them stop!"

Then we flipped the control switch to
e 43K (43,000 ft.), max setting for
rced breathing. I swear there were ele-
hants roaring outside the chamber—
ubbering, drunken elephants from the
und of them. Either that, or some gi-
t squatting nearby after eating his fill
beans. . . .

The instructor asked one of the stu-
nts the name of her school. All you
uld hear was mumble, mumble, mum-
e. Yeah, I went to that school, too.
ood old Mumble University. Actually,
e did a good job under the circum-
nces. I don't think I could have gotten
squeak past that hurricane in my face.
ter this, I would say those scenes of
aracters discussing dinner plans dur-
g high-altitude maneuvers are not very
alistic.

Then we went back to the normal set-
g. The director, in his best Mr. Rogers
ice, said that it might feel difficult to
eathe again for a moment. He said we
re pulling air through about four feet
hose, but the instructors had about
twelve feet to suck through. Four feet, twelve feet, who cared? My right brain was shouting, "Suck, suck, there's not enough air!" However, my left brain noted the gauges were all showing 300 pounds of pressure like they were supposed to, and the little white toggle was going white and blank in a nice even rhythm. Everything was fine.

Rather suddenly, it felt like the air conditioner had kicked in. We were going up (in simulated altitude), and the temperature drops two degrees Fahrenheit per thousand feet. There was a thermometer in the corner. It said 60 degrees.

At 5,000 feet, my ears popped. I was almost disqualified for the test because I couldn't get my right ear to pop. They had me snort a bunch of Afrin just before I got in the chamber. I could still feel it sliding down the back of my throat. Although antihistamines make cells less efficient at taking up oxygen, nose spray takes about an hour to get into the blood, so can be used just before flight. Heroes with hayfever take note.

The instructor asked at what altitude the military requires the use of oxygen? I answered, "10,000 feet." He said, "That's right, Number 3." Number 3 was the number above my seat. All the odd numbers were on the left and the evens on the right side of the chamber. There were 12 of us, plus a doc who was getting recertified.

The instructor asking questions helped me keep the left brain in control, even though my body complained of being uncomfortable. My stomach felt like I'd swallowed the balloon (green, of course) hanging in the chamber with us. At 18,000 feet, the balloon would grow to twice its normal size. By 25,000, it would be three times bigger. Other trapped gas was busy escaping, requiring even the most refined lady to fart loudly. Why don't we ever hear about *that* in a science fiction story?

The test director told us to uncross

our legs. We needed to keep our feet on the floor so nothing would go to sleep on us.

We hit 18,000 feet and "leveled off." The director asked what was significant about 18,000 feet. I couldn't remember. Number 7 answered, "It's when we are through half of the atmosphere." That's right, I thought. They covered that in class. I've been told that in a real emergency, your short-term memory is the first thing to go. Only things that have been drilled into you remain. Our fictional heroes had better be well-trained. Something heard once is not going to be remembered in an emergency.

The director asked how long a time of useful consciousness we had at 18,000 feet. I think it was Number 4 who said, "20 to 30 minutes." I thought, a lot less if you're not paying attention!

NASA photo

The odd numbers were told to disconnect their masks and turn off their oxygen. This was it. The big test. Would I turn into a babbling idiot? Act like a drunken fool? I reached across my mask to the right side and punched the little button by my nose. The cup of the mask fell open. I was surprised the air didn't feel cold in my nose and also that it didn't feel "thin." My right brain was very happy to get that suffocating mask off even though my left brain knew this meant I wasn't getting sufficient oxygen. In a real emergency, the right brain is often dominant. I'd heard stories of divers found dead with perfectly good oxygen tanks beside them. I believe those stories completely.

The instructor said it had been 30 seconds. My heart did a flip-flop. I got a sharp sinus pain between my eyes. We'd each been given a clipboard with a worksheet on it for us to fill out while we were hypoxic (suffering from a lack of oxygen). I looked down at my clipboard. Multiply my age by three. Usually, I can do this kind of thing in my head easily. But the stabbing pain between my eyes made it hard to concentrate. I wrote the problem out. At least I got it right. Then I had to subtract 17 from m age. I got it wrong, but I thought it wa right. Then I had to add 33 and 37 Everyone knows that 3 and 3 is 9, plu one is 10, right? The answer was 100 . . I was doing great! That pain wasn't suc a big deal after all. Now how do you subtract a bigger number from a smalle one? Ah well, I'll just skip that one.

Could I drive a car? Of course not. M hands were too shaky. I wrote "no."

On the video later, I head the test director say it had been two minutes. I ignored him. I had this worksheet to do My three signatures were each wors than the last. Maybe I should be a doctor? The test director asked how w were feeling. Instead of pushing the tal button to answer, I wrote "dizzy" on m sheet. My little finger was numb. It wa hard to hold the pencil. List the presidents in reverse order? No problem Everyone knows Clinton is presiden and Bush was before him. But who wa before Bush? Who cares?

I checked my fingernails. I couldn't r member why I was doing that. (The turn blue.) Did the test director ask us t do that? I should do what he says. Oh yeah, I am supposed to check my peripheral vision. I waved my hand by m face. Hand looks fine.

How many of us can identify thre symptoms of hypoxia? I wrote, "clumsy," "heart rate increase," and "pressur behind eyes." I was done! We had t identify three symptoms, and then w were done. Like a kid in school, I raise my hand.

My response here may or may not b typical, but someone caught in a depre surization is not likely to be able to ca ry on an intelligent conversation or a ticulate their last requests. They a likely too happy to care if they die not, and unless the outside orders a childishly simple, and the person h been trained on what to do, there is n much hope they will save themselves anyone else.

After I raised my hand, I fumbled wi

the three switches required to turn the oxygen back on. However, I couldn't put my mask on. Not only did my right brain not want that thing on again, but I couldn't seem to feel the latches. Next thing I knew, the doc was hooking up my mask for me. His action irritated me. wanted to do it myself! However, once the air was blowing in my face, I was content. I watched the little white toggle go white then blank, white then blank. Isn't that neat how it does that? Gradually, my head cleared, and I realzed that my test was over. Maybe it was lingering effect of the hypoxia, but I elt euphoric. I had done it! I was okay! I was going to fly next week!

The analytical left brain was quickly back online. It noticed both my little fingers were completely numb. No wonder couldn't feel the latches, and the doc had to help me. The pain between my yes subsided, but my fingers throbbed while the circulation restarted, like when you fall asleep on your arm. So, on't expect a future hero to be able to hoot a ray gun while hypoxic!

While the odds recovered, the evens ook off their masks. Number 2 put on uite a show. He sat there grinning like a monkey. "Hey Number 2, what's your ame?" Grin. The doc took Number 2's encil away as he was about to poke imself in the eye with it. "Number 2, ook at your fingernails." Grin. "Number , nod if you hear me." Grin. The doc ad to hit Number 2's switches and put n his mask for him. He just sat there. ow I understand why they tell adults n airplanes to put their mask on first, hen take care of the kids. However, I ould bet that most kids would tear it f inside 20 seconds.

A woman on the even side was the rst to put her mask on. The director aised her for doing it right. She logged er symptoms, stayed in control, and ok corrective action. That was the urpose of the test. To find out your ody's reaction so you can recognize it time to take corrective action if the KC-135 loses pressure during free-fall from 35,000 to 25,000 feet.

At 25,000 feet, you have only three to five minutes of "useful" consciousness. After that, you may be alive, but unable to respond. At 35,000 feet, you have 30 to 60 seconds, and above 43,000 feet, only *9 to 12 seconds.* I had experienced three minutes of hypoxia. I wondered if I could get to my seat and don an oxygen mask in three minutes under emergency conditions? I hope to never find out. But one thing for sure, I'm more likely to now than before I had this training.

The descent went quickly. I unfastened my mask so I could hold my nose and force my ears to pop. The right one popped, but not the left. I kept taking off my mask, swallowing while holding my nose pinched shut, forcing pressure on the inside of my ear drums. (This is called the Valsalva maneuver.) I heard lots of crackling sounds, like a fire made with wet wood. If the Eustachian tube is blocked so that the inside of the eardrum can't repressurize, the inner ear will fill with fluid to compensate. This is called ear block and can be painful, especially if it becomes infected.

Disconnect time. I unscrewed the connection wrong, but the doc unhooked me. I felt a bit shaky, but amazed I had survived this. I hadn't wanted to really believe that I was going to get to try out free-fall until this was over. Now I could believe it. I was going!

They marched us out and took our masks. I retrieved the bottle of Afrin they had given me as a souvenir. We then got to watch the video of our test. Number 2 said, "You were all laughing at me!"

The doc passed out green badges to all of us which said "Hazardous Duty" in red letters. On the back it listed delayed symptoms of decompression sickness: "Severe headache, disorientation," etc. Now that we were back at sea level, the extra oxygen we had in our systems would be outgassing overnight. We might feel pressure in our ears. We were not to take any analgesics or drink alcohol or exercise because these would mask symptoms such as ear pain, disorientation, or bubbles of nitrogen in our joints. If we had any symptoms, we were to call the number on the badge. Severe problems are treated by a return to the chamber.

We had to take a written test of 42 questions. You know 42: in the *Hitchhiker's Guide to the Galaxy,* 42 is the answer to the question "what is the meaning of life." I didn't miss any, so I earned a pretty blue certificate with a gold seal on it. And, I got a little blue card that was my ticket to fly into simulated space on the KC-135.

Eight hours later, I had a headache, and my left ear wasn't quite clear. I also was not as hungry as usual. I woke up that night with my knee aching and wondered if I had a bubble in my joint. The doctors had said that if it is a bend, it will not feel better when you stretch and exercise it. I got out of bed and stretched. The knee still ached, but not enough to keep me awake. I decided it was just a leftover from my martial arts practice a few days before. I went back to bed, and it was gone in the morning.

I only had a few minutes of hypoxia, so I would expect a fictional hero to have more severe physical symptoms. But emotionally, I felt extremely pleased with myself. I had overcome my fear, gotten through the test, and survived a real decompression. Next up: weightlessness and two *g*s.

Part II

Weightlessness and Two gs

Aboard NASA's KC-135
(a.k.a. "The Vomit Comet")

Free-fall on NASA's modified KC-135A turbojet, affectionately called the Vomit Comet, was, if you'll excuse the pun, an uplifting experience.

First, I'd like to explain what causes weightlessness. It is not the lack of gravity. If you built a tower 200 miles tall—the altitude of space flights—the gravity at the top would be about 90 percent o that on the surface of the Earth. If you stepped off, gravity would yank you down to splat at the base of the tower. I you took a running leap, you would hi the ground farther from the base. And i you propelled yourself fast enough—about 18,000 mph—you would essentially jump past the horizon. Instead o going in a straight line, gravity woul bend your path so you would fall in a circle around the Earth. You are not in zer gravity, you are in free-fall. However things in free-fall are "weightless"—meaning that gravity is not pushin them *against* anything—just as the would be in true zero gravity such as a the center of the Earth.

The K-bird flies a roller coaster profile, free-falling down 10,000-foot "hills forty times per flight. This profile provides 25 seconds of weightlessness alte nating with pullout periods of twice th force of gravity (two *g*s). The safet video during our required prefligh briefing warned us not to walk aroun during the high-*g* pullout maneuvers. I showed actual footage of someon falling and breaking two ribs. (Musica chairs in high-*g* environments is dange ous!) We were instructed how to exi the plane using ropes, how to inflate lif vests, and how to keep rafts together i case of a water rescue. The video ende with a statement I would expect an earl space tourist to hear: "This aircraft is no an FAA-certified aircraft. That doesn mean it's not safe. It just means tha there may be an exclusion clause in you insurance policy, that if you're injured, won't cover you." We all had to sign statement explaining that we unde stood and accepted the risk.

The video was followed by a lectur from the flight surgeon who made su everyone had several barf bags. He i sisted we shake the bags open and hav them ready in our breast pocket, "Because if you get sick, sometimes the onset is so fast, you cannot get your bag out. [You] fiddle with it, try to open up the envelope. By that time, you're throwing up in your lap." He also said not to "hold the bag so tightly there's no orifice. If you throw up into that, it goes this way [pointing to his face]. I've seen that a thousand times." I doubt a space flight attendant will be as blunt. Our space tourists may be in for some unpleasant surprises.

The doc then handed out the standard oral motion sickness medication, which takes about 30 minutes to take effect. My doctor had given me a faster-acting topical to use instead. I misunderstood his directions and overdosed myself by a factor of two by rubbing it on the inside of my elbows and behind my ears instead of either/or. The NASA flight surgeon told me the pills wear off in six hours, but the topical would last 12 to 24 hours. He warned me to watch out for hallucinations and euphoria. A real space tourist could easily have these reactions.

We took off from Ellington Field at 9:30 A.M. During the 15-minute flight out over the Gulf of Mexico, my neck felt constricted—another effect of the motion sickness drug. I eagerly—in hindsight, euphorically—anticipated my first experience of weightlessness.

Once we reached about 25,000 feet, everyone unbuckled and went forward to set up their experiments. There were six teams of two students each with some journalists, like me, along. Kelly McAllister and Jennifer Jones were "my" students. Their experiment involved inecting olive oil into test tubes of water and videotaping the resulting mix of bubbles in weightlessness.

With my camera around my neck, I trapped down on the floor across from he students and their experiment. The whole interior of the K-bird (including he restroom) is covered in white oam—a genuine "rubber room." The test director hollered, "Five minutes!" He had to holler because the engine noise was incredible. The yellow foam ear plugs hardly helped.

"Two minutes!" I tightened a yellow strap across my legs. What would it feel like to be weightless? I imagined my hair waving as if it were under water, and me pushing off with a finger and floating.

The first high-g maneuver pressed us to the floor. The engines roared and vibrated with the strain. My face sagged, and my camera became a huge weight around my neck. The heaviness lasts much longer on the space shuttle, and I think most tourists will find it uncomfortable—especially older people with bladder control problems and women in the midst of their periods. You can't get up during this time, but space tourists can take comfort knowing that even astronauts wear diapers during ascent.

I spoke into the tape recorder which I had Velcroed to my wrist. "We're getting there," I said. "My head feels a little strange. I feel like my whole head is sinking, really pushing down the back of my neck. It's really an odd sensation. I don't want to move at all." Then suddenly, I exclaimed, "Oh! Now I'm floating! Everything is free. Oh my gosh, I'm floating!"

NASA encouraged us to take along "pocket" experiments. I had decided to test my "Jedi" abilities using a red pencil and a little plastic Yoda. I let them both go in front of me. I planned to direct their movements with the "Force." They immediately started tumbling away in opposite directions. Chaos is stronger than the Force? I grabbed both out of the air, tangling my feet in the yellow strap, and decided to try again after I learned how to move around in weightlessness. The flight director called, "Feet down!" in preparation for the pullout. Our first 25 seconds were up.

As we leveled out, it rained balls of wayward duct tape, paper clips, beads of water, and my camera bag, which came thunking down beside me. When our future tourists return from space, unsecured luggage and refreshments are going to pelt everyone. Some kids are sure to use this effect for messy pranks which adults will not find amusing.

As we started up the next "hill," I said, "The feeling on the back of my neck is returning. I feel really heavy, with a hound-dog jowl." A few minutes later, we were in free-fall again. The foam walls, pressed down during the pullout, bounded back to their original shape, pushing everything into the air. "I'm going up!" I exclaimed. I lifted my camera from my lap to take a photo of Kelly and Jennifer. "Oh gosh, I'm going backwards! My feet are in the picture!" Just lifting my arms had caused me to do a flip. To stop my roll, I grabbed a floor ring. My camera kept right on going, though, and slipped over my head. I nabbed it out of the air about the time the director yelled, "Feet down!"

My photos showed the girls' faces were almost instantly puffy. This effect is caused by body fluids, usually held down by gravity, shifting upward. It makes your head and nose feel "stuffy," the way it feels when you hang your head over the side of the bed. I think all of the babies on the tourist flight will wail when this happens, but the older women will be pleased to see their wrinkles disappear.

We started up the hill again, engines roaring. Even though the nose of the plane pointed up, inside, the belly of the plane felt "down." I'd been told that when you are weightless, you automatically shift to a body-axis coordinate system. In other words, up is the direction of your head. It certainly was the case for me.

Astronaut Bonnie Dunbar had suggested taking the high *g*s sitting up rather than lying down, so that's what I did. An experienced student suggested closing my eyes during this time. I tried that, and it had a calming effect. But my stomach fizzed like a badly shaken soda. I reported, "I'm feeling hot . . . and I think I'm going to be sick." Future space tourists should consider packing cold packs or portable fans.

My ears were telling my brain that I was falling, my eyes were telling it that I was sitting on the floor of a plane, and the fluid shifting from my lower to upper body told my brain that I was upside down. This sensory conflict causes space motion sickness. I tried, but I could not ignore the way my stomach churned.

I didn't want to risk throwing up on my camera, so I yanked the strap over my head in preparation for putting it away. This motion sent me flailing into the air. It was too much for my poor stomach. I used the bag and was instantly reminded of Newton's law of action and reaction. The vomit bounced off the bottom of the bag and came right back into my face! Yuck! Luckily, the doc was there instantly with large tissues. Hopefully, commercial space flights will have better barf bags, but just in case you end up in third class, here's a trick that really works: to prevent backlash, stuff a few tissues into your bag.

Like a good tourist, I still had my camera by the strap, but the little string holding the lens cap had come unglued I nabbed a piece of duct tape and stuck it back on—a souvenir that remains on my camera today. I took the next high-g pullout lying on my back. I decided this felt better than sitting up because the contents of my stomach were pushed to the back instead of "down." This avoided them springing up into my throat when I was weightless again.

But it seemed no matter what I did, spun around while weightless. I soon felt the urge again, and my other bags were in my leg pouch. I struggled to ge one out and tumbled so that only my lef foot was attached to the yellow strap The doc helped me to the back of the plane. I fumbled with the seatbelt, feeling like an idiot because I couldn't get i to latch. Just the lightest touch sends you flying. I predict tourist flights wil be fishbowls of loose chewing gum wrappers, overcoats, and cameras.

Although we were not allowed to move around during the high-*g* pullout, some people did take it standing up, and I think I could have done it at least once. However, I know I would have paid for it later. Just holding my head up left me with a sore neck for several days.

After the tenth parabola, the plane did what was called a turn-around maneuver—flying out over the Gulf. I started to feel better right away, and was thinking of moving back to my place near the students. However, I quickly got sick when the roller coaster started again. I therefore hope that tourist flights will offer a human centrifuge with artificial gravity to help those people whose stomachs need a more gradual transition.

Meanwhile, the students were having the time of their lives. Over the roar of the plane, I recorded Kelly's high voice saying, "This is awesome!" over and over while bouncing off the ceiling. Unfortunately, the oil in their experiment didn't do much bouncing. It stayed on the end of the needle in a blob instead of shooting off and mixing with the water. Overnight, the students adjusted the injection speed and got better results on the second flight.

My pocket experiments didn't rate a second chance, so I was grateful when a student offered to do one for me. He attached my bag of blue water to a yellow strain gauge and took pictures of it during free-fall and at two *g*s. Curiosity overcame nausea long enough for me to float above my seat and watch him. I had hypothesized that the water would form into a ball inside the bag. It didn't. It stuck to the sides of the bag, with the main air bubble in the middle. The photos didn't turn out very good—it's extremely difficult to maintain focus on an object while both you and it are floating. So much for pictures of UFOs out the cabin window. . . . However, the fact I could control my stomach long enough to watch indicates to me that if our future tourist had some important task to do, unlike being hypoxic, she could probably do it despite being motion- or space-sick.

Another of my pocket experiments required me to wrap a tape measure around my neck and record the result at zero and two *g*s. I hypothesized that the fluid shift during weightlessness would increase my neck size, and that it would decrease during two *g*s. (Before 007 goes into free-fall, he might want to loosen his shirt and tie!) I had a small mirror to strap to my wrist in order to read the tape. But in weightlessness, the tape was like a slippery snake. I needed two hands to keep track of it, and I needed one to hold my barf bag. Space-tourist gadgets should require only one hand!

After nearly two hours of alternating between being weightless and weighing two *g*s, I felt like a rag doll slammed against the wall one too many times. My eyes teared up during free-fall (blinking does not get rid of them!), and the tears were literally yanked from my eyes during the pullouts. They thwacked audibly on the top of my shoes. When I got home, my wrist was bruised from where the tape recorder rested on it during the two *g* periods. Children and old folks may have bruises under their heavy watches or jewelry.

When the director said the last "zero" was coming up, I took Yoda from my pocket, determined to try that experiment again now that I knew how to hold still with my feet. I released Yoda and successfully got him to hover in front of my face. I held my breath so as not to blow him off course, and thought, "Come," at him. He hit me in the forehead!

Then the director yelled, "Feet down." I grabbed Yoda and slipped him back in my pocket. An unscientific trial of one, but I was pleased that the "Force" had seemed to be with me. I was most disgusted when I learned later that there are residual forces from the front to the back of the plane. . . .

Next was lunar gravity for about 30 seconds. I tapped my foot on the floor and bounced just like in free-fall—and threw up just like in free-fall. Then we tried Mars gravity. The Moon was too little, the Earth too much, and Mars was just right as far as I was concerned.

Everyone returned to their seats, and we touched down about 20 minutes later. I thought, finally, I am going to be all right. But I was still nauseated. The doc said I should go get some fresh air, but I just wanted to sit still and wait for my stomach to settle. I even missed the group photo. Eventually, the doc escorted me down the steps. I asked how many people react like I did. He said about 1 percent. Why did I have to be in that 1 percent?

I shuffled into the briefing room, struggled out of my flight suit, and promptly threw up again. I was shaking with cold, so someone tossed me a blanket. This sure wasn't how I wanted my story to end, but this was reality, not fiction.

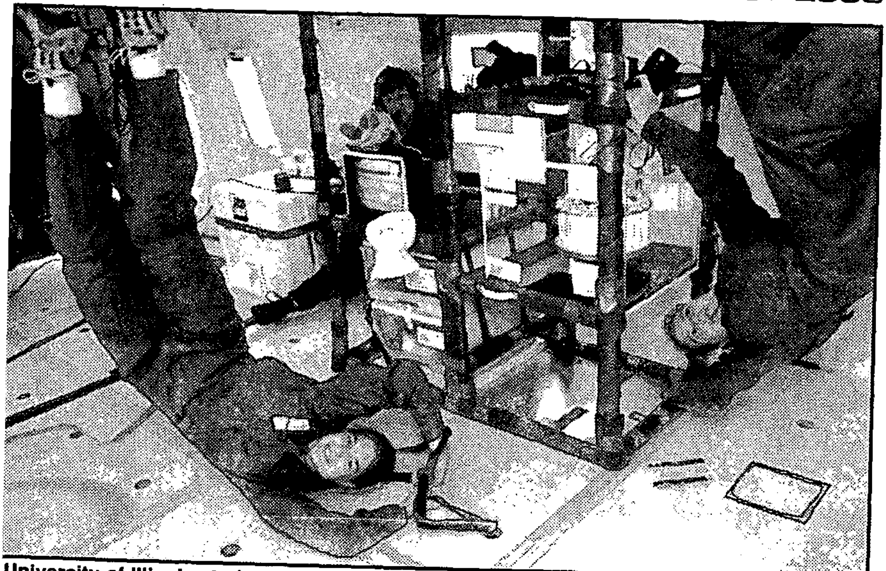
The doc told me to go home, drink plenty of juice, and just sit. He said a warm shower might help, too—but to avoid a hot shower because it might make me faint. My heart was still doing double time, and I felt very light-headed. I hadn't felt dizzy in the plane, but now on the ground, I did. It wasn't a dizzy like you get when you see dots before your eyes. It felt like my head was bigger than normal and wanted to flop to the side. I didn't have a headache, and my ears didn't hurt like after the hyperbaric chamber. If I had to experience both at once, I would have been a real basket case! I didn't trust myself to drive, so I had someone take me home. I felt nauseated the rest of the day. So much for motion sickness drugs!

When I got home, I sat on my couch with the cat and a blanket over my legs, and thought about what my reaction to free-fall meant to my future. Flying into space has been my dream ever since I read *Starman Jones* in fifth grade. Should I forget about going into space? I had lost five pounds in three hours. My gut hurt, my throat burned, my muscles ached. I went to bed feeling rather depressed about the whole thing.

The next day, I felt weak, but otherwise fine. I found that 15 of the 18 people on my flight had been sick, tied for the record. The flight directors insisted that motion sickness does not correlate with space sickness, and most people adapt even to the Vomit Comet after a few flights in the same week. Maybe so, but I don't want to find out I am one of the ones who won't adapt *after* I've paid a fortune for my space trip. And the percentage of astronauts who get space sick is over fifty. I suspect it will be even higher for the general population. Who wants to be sick for two full days? I could barely cope with two and a half hours.

So, do I still want to go? That depends. Since I've flown and admitted how sick it made me, others have privately shared their own "uplifting" experiences. I've found that most healthy people would not pay money for something that makes them sick enough to throw up. Therefore, I am optimistic the eventual space tourist industry will find space sickness drugs that actually help, create backlash-free barf bags, offer artificial-gravity hotel rooms, and provide partial refunds with "bailout" options for people who don't adapt after a trial period. With these concessions to reality, I still dream of being a space tourist.

How about you? ■



University of Illinois students Kelly McAllister (left) and Jennifer Jones (right) prove there is no up or down when weightless.

About the Author

Marianne Dyson has been appearing regularly in the pages of *Analog* since her first story, "Fireworks in Orbit" appeared in the August 1990 issue. A former NASA flight controller with a degree in physics, Ms. Dyson is now a full-time writer. Her first

For More Information

For more information on the University of Illinois team experiment, "Flow Characeristics of Immiscible Fluids in Microgravity," visit: http://www.uiuc.edu/ro/floatn.

For more information about the NASA Reduced Gravity Student Flight Opportuniies Program contact Burke Fort, the Project Director, or Donn G. Sickorez, the Uniersity Affairs Officer.

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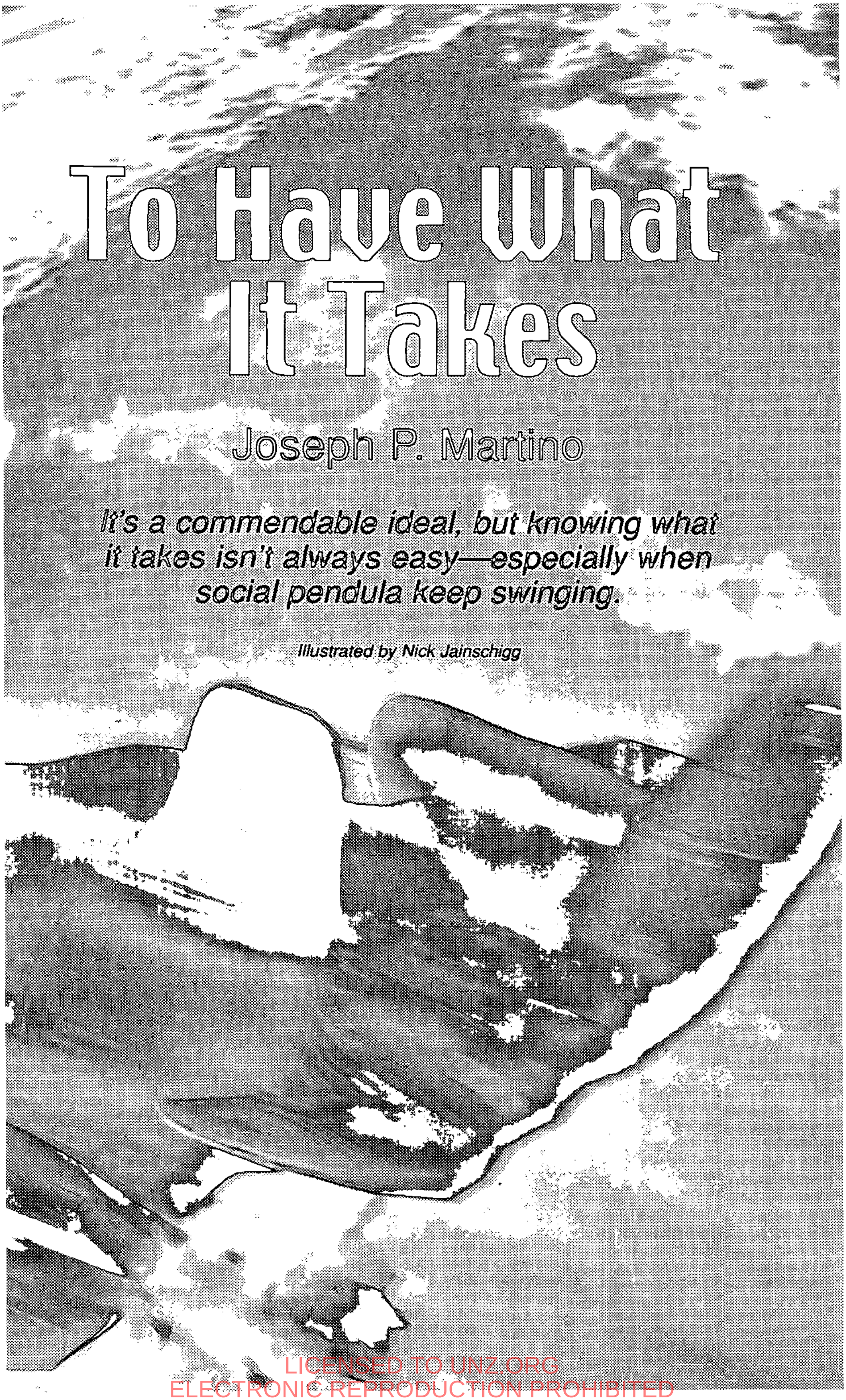


To Have What It Takes

Joseph P. Martino

It's a commendable ideal, but knowing what it takes isn't always easy—especially when social pendula keep swinging.

Illustrated by Nick Jainschigg

There was blood upon his faceplate,
Bloody froth upon his nose,
And air was whistlin' through the holes
In his breather hose.
His skin was turnin' purple
From his head down to his toes,
And he ain't gonna fly no more.
Gory, Gory, decompression,
Gory, Gory, decompression,
Gory, Gory, decompression,
And he ain't gonna fly no more.

Mike Sweeney looked around in the tight little cockpit of his SF-83, the hottest and newest fighter the Space Service had. Meticulously he went through the checklist to make sure every switch and dial setting was correct. Then he looked through the canopy. The SF-83 was designed to operate on the margin between the atmosphere and space. It had attitude-control jets, and two rocket engines with their nozzles behind him. It also had short, stubby wings, and a conventional aircraft tail assembly, with the rudder above the rocket nozzles and the elevators on either side of them.

He looked carefully at each wing. The wings were designed to fold at midspan, to fit into the bay of the carrier spacecraft, the "mother ship." He verified that they were locked solidly at the hinges. Below the wings were the inboard and outboard racks of missiles, their noses protruding ahead of the leading edge of the wing. For this flight the missiles were dummies. They had the same weight and balance as the real thing to assure that the fighter would fly as though it were carrying live weapons. The dummy missiles were crammed with test instrumentation, to measure every aspect of the vehicle to the last decimal.

He used the side-arm controller to wiggle the control surfaces on the wings. The ailerons were split at the wing hinge, with the two halves operating independently. This was so the inner halves could be used as flaps, on those rare occasions when the fighter might actually have to land on the Earth's surface. Ordinarily, the outer halves were slaved to the inner halves by a servomechanism. Thus even if the wing took a few hits, the outer aileron would still match whatever position he moved the inner half to. Satisfied that the ailerons were working properly, he craned his head around, wiggled the side-arm controller again, and watched the tail surfaces move in response.

Finally he leaned his head back as far as it would go. He could just barely make out the fighter-carrier that had launched him only a few minutes before. It was in a higher and slower orbit, and he wouldn't be seeing it again until this test flight was finished. And above him, he could just pick out his chase plane. It was a reliable but older SF-80, hanging above and slightly behind him. If he ran into any problems, the pilot of the '80 was his link to the test flight center back on the fighter-carrier. He spoke into his microphone, to make sure the link to the '80 was working.

"Blue Two, this is Blue One. Checking communications link."

"Blue One, this is Blue Two. I read you five by five. Good luck, Mike."

His official checklist finished, he began his private ritual. First he crossed himself. Awkwardly, because the designers of his pressure suit had never anticipated *that* maneuver. Then he recited his usual prayer. He had read that some old king of England used to recite it on the morning before a battle. Somehow it seemed to fit his job too.

Lord, I shall be busy today. I may forget Thee. Do not Thou forget me.

Then he had a few minutes to relax. His trajectory would take him deep into the atmosphere. But not at a steep dive. Not after yesterday's accident. He would be coming in at a shallow angle.

Below and ahead of him he could see the northern Pacific, dotted with clouds. The sun was just above the eastern horizon, giving the cloud-tops a pinkish cast.

It was just after dawn down in Hawaii. The clouds were especially heavy just off the coast of California. The coastline was completely obscured.

As a child, he had watched clouds from the underside. He had daydreamed of wending his way up and down the fluffy white canyons. When it came time for college, for him there was no choice but CalTech and its Aero Engineering school. Upon graduation, the only choice was pilot training with the Space Service. Once in uniform, the only choice that interested him was fighters. After his first duty tour in a jet fighter squadron, his next choice was space fighters. After that tour was behind him, his only choice was to become a test pilot. That way he got to fly the newest and the fastest before the other pilots got their hands on them. And he got the chance to demonstrate that he had what it takes to be a test pilot. Step by step, he'd climbed the pilot's pyramid, and finally he was at the top.

The timer on the control panel counted down to zero, and suddenly he was too busy to think of anything but his job. He had to start paying attention to the dynamic pressure on his aircraft, not to the view.

At first as the air thickened he could hear it as a thin high wail. Then the craft started buffeting. He rapidly alternated his attention between the radar altimeter and the airspeed indicator. He wasn't supposed to go below sixty kilometers altitude, and the dynamic pressure was supposed to stay below the equivalent of 500 kilometers per hour at sea level.

As he started to approach the critical values, he pulled back on the controller and felt the *g*-force begin to tug at him. The *g*-force built up, and the altitude ceased dropping so rapidly.

He felt a low buzzing in the controller and looked out of the canopy. He could see the missiles on the inboard racks vibrating slightly. Evidently they were developing a little flutter. Well, the onboard instruments would record it in detail, and the telemetry routed through Blue Two would inform the test controllers of it. Probably the racks needed stiffening a bit. Then he was on his way back up again. He kicked in the rockets, just long enough to replace the speed he had lost to atmospheric drag. This put him in a new orbit, in the same plane as the old. He would begin his descent just west of England, and re-enter the atmosphere over the west coast of Africa. There he would perform his next scheduled maneuver.

"Blue One to Blue Two. Everything okay so far. Out."

"Roger, Blue One. Out."

The baby cried out from the next room. Carolyn Sweeney turned quickly to go see what was wrong. Her elbow brushed a picture off a knickknack shelf. It fell as though in slow motion, fluttering slightly. She made a grab for it. The Coriolis force made her misjudge its fall. Her hand merely ticked the edge of it, knocking it farther away and starting it tumbling rapidly. She let it fall and strode toward the nursery.

Susan whimpered once more, then began the sing-song crooning that meant she was going back to sleep. Carolyn walked softly the rest of the way to the door and peeked in. Satisfied the baby was all right, she turned back to pick up the picture.

It had landed face down. She picked it up, turned it over and examined it thoughtfully. It showed Mike in the black and silver uniform of the U.S. Space Service. His face held the strange combination of boyishness and determination that had first attracted her when they'd both been students at CalTech. He really ought to get a new picture, she thought. This one still showed him wearing captain's bars, and he'd been a major for over a year. She replaced the picture on the shelf, next to their wedding picture, in which he wore full dress uniform, and the pictures of their parents. The pictures were thin plastic sheets. The thicker plastic around the edges was more of a stiffener than a real frame. The pictures, like nearly everything else on Grissom Station, were as light as possible. Every gram lifted up from Earth cost fuel, which translated into money.

There were nearly three thousand people on Grissom Station. Mostly Space Service and their families, plus a few civil servants, and some field service engineers from the various aerospace contractors. But Carolyn and Mike's social life revolved around the three dozen people in Mike's squadron. That social life was mostly a series of dinner parties, like the one she was having tonight. She hoped Mike would get back from his test flight in time to help her get ready. In the meantime, she had a problem.

She had invited six couples. But Tom Harper had bought the farm yesterday. Mary Jo would be busy packing to leave the station. She had automatically become disinvited the instant she became a widow. Not that the wives in the squadron had abandoned her. They would all be spending some time with her until she departed the station. They'd help her pack, watch her twins, and just listen while she talked or cried. But already she was a *former* squadron wife.

For a moment Carolyn wondered if she ought to cancel the party. She usually got upset at the parties anyway. The men always ended up in one corner, doing what they called "hangar flying." And the wives ended up somewhere else, talking about everything but the dominant thing in their lives, the worry that was their constant companion every time their husbands went on a test flight. And sometimes the men ended up singing those horrible songs about pilots getting ki—

No! Stop that, Carolyn, she told herself. You accepted Mike as he was. All of him. Not only as a loving husband but as a pilot. And now as a test pilot. Keep up your end of the bargain.

So back to the invitation list. To have two vacant chairs as a reminder of the loss would be unthinkable. But to call up another couple at the last minute would be even more unthinkable. It would be another, more subtle, reminder that the Squadron had suffered another loss. Then she had it. The Wilkinses had just arrived on the Station. Bud had been assigned to the Squadron for only a few days. It was time to get them involved in the Squadron's social life. The party could be an icebreaker for the Wilkinses, and no one would think anything of their presence in place of the Harpers. She reached for the telephone.

They handed him his orders up on
Grissom Station,
Sayin' Jack you're away behind time.
You'll not fly an SF-Eighty but an old
'Forty-seven,
You must ferry her to Luna on time.
He looked out to starboard at his black-
painted wingman
Keepin' station at four o'clock low.
Then he called on the squawk-box,
When I firewall the throttle
You will see this 'Forty-seven go.

Mike watched as the west coast of Africa crept above the horizon. The lights of a few major cities punctuated the darkness. He had personally filed the mission's flight plan, so that Africa Control could make sure he had a clear corridor for his maneuvers. No point in letting a slip-up by some clerk endanger not only the test but some innocent bystanders.

As he relaxed for the moment, he reflected that he was an experimental test pilot, in an elite squadron of the Service's best test pilots. He was a member of a proud profession whose origins could be dated precisely. Prior to the Wright Brothers, every would-be inventor of an airplane had conceived the role of the pilot as nothing but a chauffeur. The pilot's job was seen as steering the plane where it was supposed to go, nothing more. Samuel P. Langley hadn't been at the controls of his Aerodrome himself, not because he was afraid, but because he imagined the pilot to be little more than a coachman.

Orville and Wilbur had realized that, like a bicycle, an airplane was an unstable vehicle. The pilot would have to *fly* it, not just steer it. He would have to be inside the control loop and play an active role in correcting for the airplane's departures from the desired flight path. Moreover, the Wrights were aware of the limitations of their wind-tunnel test data. Some of the experimental data they needed could only be gathered in flight with a full-sized airplane. This presented them with a problem.

How could the very first airplane have a pilot, when there was no way to train a pilot without an airplane? They couldn't tell a pilot what to do. They themselves didn't fully understand how an airplane would behave. That couldn't be earned without actually flying one. So hey taught themselves to fly. They praciced with man-carrying gliders, over he soft sands at Kitty Hawk. When they crashed, they were only shaken up. They weren't killed, as Otto Lilienthal had been killed in a hang-glider crash on an unforgiving hillside. They were the world's first test pilots.

From then on, the job of the test pilot had been to verify the calculations of he designers, in the only way they could be verified: in actual flight. Test piots were the ones who went out to wrest from a grudging Nature the knowledge that allowed others to fly in afety.

Mike's classmates from CalTech were designers of all kinds of aircraft and pacecraft. But he was one of those who made sure that all the equations balnced. If something went wrong, for the designer it was "back to the drawing board." For the test pilot, an unforeseen design flaw had a lot more personal impact.

He thought back to yesterday's briefing, after Tom Harper's mishap. Tom had been taking an SF-83 on a steep dive into the atmosphere. The flight plan called for a descent to fifty kilometers, at which point he was to have pulled up and climbed back into space, pulling six *g*s. But something had gone wrong. At the start of the pull-up, the cockpit canopy had shattered. A manufacturing defect in that particular canopy? A design flaw which didn't allow for the combined air pressure and *g* stress? No one knew yet. The engineers were still back at their drawing boards, or more likely at their Computer Aided Design workstations. The shattered canopy alone wouldn't have hurt Tom. In combat, a canopy is sometimes shattered by enemy fire, and the pilot can survive. A fragment of the canopy had cut the hose that connected Tom's pressure suit to the oxygen supply in his craft. That wouldn't have killed him, either. He had an oxygen bottle on the suit itself, as a backup. But the examination of the craft, recovered in space, showed that Tom hadn't made sure the oxygen bottle was properly connected. When the canopy went, he had about thirty seconds of consciousness before anoxia set in. He held the craft in its climb for those thirty seconds, else no one would ever have known what happened to him. But a mistake about an oxygen bottle is one you don't recover from.

After the briefing, the pilots had all nodded knowingly to one another. No one spoke, but they all knew what they were thinking. Old Tom might have been a pretty hot rock of a pilot when he was back in a fighter squadron, but he didn't have what it took to be a test pilot. When the crunch came, his own carelessness killed him. But *they* all had what it took. None of *them* was going to be caught short like that. And later, on the transfer vehicle from the fighter-carrier back to Grissom Station, the pilots sang the old songs about pilots who hadn't come back, songs that in many cases could be traced back to the beginnings of aviation.

Carolyn pushed the button beside the compartment door. Mary Jo Harper's voice came through the annunciator.

"Who is it?" The voice seemed flat and tired.

"It's me, Mary Jo. Carrie Sweeney."

"Door's open. Come on in."

She pushed the door open. She entered the compartment that served as a living room, and could see Mary Jo through the doorway into the kitchen. She was standing beside a table, evidently sorting kitchenware.

"Why don't you let the movers handle that?" Carolyn asked.

"I'm packing the good silver myself. The movers can mangle the rest of it, but I don't want them handling my good silver. It was a wedding present. Actually, most of this other stuff is lightweight station stuff I'll have no use for Earthside anyway. I'll give it to the Thrift Shop. It'll save someone else from bringing it up with them." She waved vaguely around the kitchen. "Have a seat, if you can find one."

Carolyn picked an empty box off a chair and placed it on the floor, then sat down.

"Where are the twins?"

"They're in the nursery. I just had to get them out of here for a while."

"Is there anything I can do for you, Mary Jo?"

"You're a dear to ask, but there's nothing I need help with right now. But I'm glad you and the other squadron wives have been coming by. I need the company. I just need someone to talk and fill up the silence."

She cleared off another chair and sat down. She brushed her forearm across her forehead, then spoke again.

"You know, I think I cried for six solid hours after Colonel Harris and Chaplain Evans brought me the news about Tom's death yesterday. Right now I'm numb. I don't have any feelings left."

"How did the twins take the news?"

"I don't think they've really understood it yet. I don't think they've absorbed the idea that Daddy's not coming back from this flight."

"They're still too young, I guess. I hope you have things to help them remember their father once they do figure it out."

"Yes. Mostly pictures, but some models of the fighters he tested, and other things like that. It's going to be tough on them, though."

"Where will you go?"

"I'd like to stay with my folks, but they were never happy about Tom's job. There would always be an unspoken 'I told you so.' I guess I'll go stay with his folks for a while. They were proud of him. After that, I don't know. I'll have to go back to work, which means looking for a job. At least there are lots of jobs for teachers nowadays, with all those private schools around."

She sat silent for a moment, then spoke again. "You know, this business of being a stirrup-holder can be pretty rough."

Carolyn gave her a puzzled look.

Mary Jo gave a quick smile before her face again took on a tired look. "Something from my history courses. Back in the Austro-Hungarian Empire. When an officer mounted his horse to go off to battle, his wife held the stirrup for him. It was supposed to show her support for him. I sometimes wonder how many of them hid bitter resentment behind the smiles they put on their faces."

She paused a moment, then continued. "With me, it was never resentment. I loved Tom for what he was, and being a pilot was part of that. But it sure scared me every time he took out a new fighter."

She tossed her head and gave a half smile. "I guess I don't have to be scared any more. But I tell you, I'd rather have him and the scares than have neither."

She grabbed a tissue, dabbed at her eyes, then blew her nose.

"Thanks, Carrie, for coming by. I know you're busy, and I really appreciate your taking some time with me."

"Yes, I'd better get back, Mary Jo, but call on me if you need anything."

"Thanks, Carrie. I'll do that."

He came down on Luna doin' nineteen
miles a second.
His retros refused to burn.
He made a brand-new crater that they
named in his honor,
One more pilot who won't return.

Mike Sweeney compared his fighter's attitude with the velocity vector shown in the inertial reference unit. In space it didn't matter. A spacecraft didn't have to be lined up with the way it was moving. But in the atmosphere it most definitely did matter. Hitting even the thin upper atmosphere broadside could do unpleasant things to an airplane.

With a few bursts from the attitude control jets, he oriented the craft so that he'd be heading into the atmosphere nose-on. Then once more he checked the maneuver he was to perform. The whole test program was intended to explore the outer limits of the fighter's performance envelope. The pilots who would fly it routinely in peace, and who might have to fly it in combat, had to *know* what the craft's limits were. When you had an enemy on your tail, it was too late to start finding out how hard you could rack your airplane around before it started shedding parts. The pilots could practice maneuvers in a simulator, rather than probe the limits themselves. The simulator could give a frighteningly realistic imitation of serious trouble, so the pilots could practice getting out of it. But the simulators had o be programmed correctly. That couldn't be done solely on the basis of design calculations. Someone had to go out and nibble at the edges of trouble to see what it was really like.

Sweeney's previous pass through the atmosphere had provided a baseline point. On this pass, he would bank to port and pull a three-*g* turn. After turning the plane of his orbit through five degrees, he would level the wings, then bank to starboard and pull another three-*g* turn until he was back in his original orbital plane. Then he would pull back up into space again. On each successive pass through the atmosphere he would pull more *g*s until the strain gauges in the fuselage told him "no more."

The air came up at him rapidly. He checked his radar to make sure the chase plane was where it was supposed to be, then started the maneuver. First, bank the wings, then pull back on the controller. The tail surfaces moved, and he started pulling *g*s. The flutter in the inboard missiles started.

The engineer half of his mind told him what was going on. There was an unforeseen nonlinear coupling between the missile racks and the wings. The designers hadn't put that coupling into their analyses, so naturally the computer hadn't told them what would happen. If the flutter got any worse, he'd have to abort the mission.

He pulled back some more on the controller to bring the *g*-meter up to the three-*g* mark. The buzz from the missile racks became a roar. The craft bucked and shuddered. The wings started wobbling visibly. He shoved the controller back to neutral, but it did no good. The bucking continued.

The engineer half of his mind told him this wasn't just flutter. It was either a manufacturing defect or a design flaw. It was crucial that he get the craft back intact, so the true cause could be determined. Otherwise someone else would have to risk repeating the experiment. Right now, though, he'd have to change the resonant frequency of something in that coupled wing-rack system before the oscillation tore his craft apart.

Ordinarily pilots never dropped ordnance this early in a test program. The sudden change in flight characteristics could throw a craft from a stable to an unstable mode. Stability is explored carefully, with and without ordnance, before any drops are made. But he was already in an unstable mode. If he didn't stop those oscillations promptly, his craft would come apart. He reacted instinctively. He turned the armament selector knob to the two inboard racks and punched the firing button. The dummy missiles should simply fall free, and the change in mass would alter the resonant frequency of the racks.

The missiles on the inboard port rack dropped cleanly. But the starboard missiles didn't make it free in time. The whole rack tore loose. He saw it bend backward, then felt a thump as it slammed the underside of the wing. It came free, and he heard two more quick thumps as it hit something behind him.

The craft bucked as the missile rack tore free, then ceased vibrating. At least he had kept the situation from getting any worse. Or had he? Suddenly he realized that the craft was rolling rapidly to starboard. He pulled the controller back a bit, and the corkscrew motion slowed. He twisted to look behind himself at the tail assembly. The missile rack had hit the starboard elevator and jammed it in the upward position it had while he was pulling gs. He no longer had any control over it. He waited until the craft had rolled all the way around to level flight, then pulled back on the controller so the left elevator matched the right elevator's position. The corkscrew motion stopped, and he was climbing back into space.

Well, that was fine. He wanted to get back into space as quickly as possible, anyway. Space, where the control surfaces didn't matter, and he could use his attitude control jets. He'd use the rockets to circularize his orbit, then rendezvous with the carrier. Piece of cake. He'd easily be back in time for Carrie's party. He fired the rockets, to boost out more rapidly.

The rockets had no sooner reached full thrust than an alarm screamed at him. He didn't need the indicators to tell him what had happened. He looked back and saw a plume of flame wash over the underside of the starboard elevator. As he cut the rockets, he could hear the aeronautical engineer half of his brain standing off to one side, observing in a detached manner that not only the missile racks but the rocket nozzles needed some beefing up. If a blow from the missile rack could punch a hole in the nozzle, an enemy hit could do so as well.

He cut off the engineering train of thought and concentrated on being a pilot. He was nowhere near his planned course. He was now heading southeast over Africa, and would soon be crossing the Indian Ocean. Where was his chase plane?

"Blue Two, this is Blue One. Do you read me?"

"Blue One, this is Blue Two. I can barely make you out, and your signal is weak. Something came off your airplane and came sailing under me. But I couldn't stay with you. I'll try to match orbits but right now I'm about five hundred clicks away from you and the range is opening. I still have you on radar, and I'll be along as soon as I can."

Sweeney suddenly felt very much alone. His signal shouldn't be weak over a range of only five hundred kilometers. The missile rack must have damaged some antennas, too. But that was the least of his problems. He was no longer flying a rocket. He was flying an unpowered glider, and one that was almost uncontrollable. He was in an unknown trajectory, and heading across a region where commercial and military flights to and from orbit wouldn't be aware he was off course.

The phone rang.

Carolyn picked it up. Someone calling regrets about tonight's party, she wondered?

"Hello"

"Mrs. Sweeney, this is Colonel Harris."

Fear stabbed at her heart.

"What is it? Has something happened to Mike?"

"Mike has run into some problems with the plane he's testing. We don't have all the details yet. However, he's still in orbit, and was still in communication with his chase plane.

"I know how the rumor mill works around here. Once word got back to the station that he'd run into a problem, it would reach you pretty quickly, and would most likely be amplified along the way. I'm calling to let you know just what the story is right now."

After a brief pause she managed to get out a reply.

"Thank you."

"Now, Mrs. Sweeney, your husband is a good pilot. He's run into problems before and managed to get out of them. I have confidence in him. I'll inform you as soon as we have any more information."

"Thank you."

"Goodbye."

Without responding, she hung up the phone and collapsed into a chair. Yes, she thought, he's had problems before, but never so bad he didn't get out of hem right away. I never even heard about them until they were solved. Mary o was right. Being a stirrup holder can be rough.

Luna City Tower this is Service Eight-
Oh-One.
've broken out of orbit and I'm on my
inbound run.
My oxy's down to zero and my fuel is
almost gone.
Please call out the crash crew, and send
them on the run.

Service Eight-Oh-One, this is Luna City
Tower.
You cannot have a crash crew, this is
their coffee hour.

Sweeney hoped the response he'd get from Air Traffic Control would be better than that in the song that had started running through his mind. He switched from the military radio channel he had been using to the air traffic control channel for Africa.

"Africa Control, this is U.S. Space Service flight Alpha One Niner Oh Two. Do you read me?"

"Roger, Oh Two," a voice came back in very precise English with a faint trace of a French accent. "We have you on radar. You are off course. Do you need a steer?"

"A steer wouldn't do me any good. I can just barely control this thing. I'm declaring an in-flight emergency. Can you give me a clear path all the way across?"

There was a brief pause, then came the reply.

"Roger. Will do. You are cleared to maintain present orbit. There is one potential conflict and we will reroute him."

"Roger that. Service Oh Two out."

"Africa Control out."

It was almost funny. He was cleared to keep his present trajectory. As if he had any choice about it. Well, that took care of the flight clearance problem. Now he had to figure out what to do next.

The doorbell chimed. Carolyn went to open the door. Mary Jo Harper was standing outside.

"Hi, Carrie. I just got the news about Mike. I figured maybe you could use some company for a bit"

Carolyn gestured Mary Jo in, and closed the door.

Mary Jo said, "I heard only that he'd run into a problem. Any real news?"

"Not really. Colonel Harris called to say there was a problem but they didn't have any details."

"So, do we cry on each other's shoulders?"

"I'm not ready to cry, not yet anyway."

"And I'm all cried out for now."

"Okay, so let's talk. I guess we can both use it." She led Mary Jo into the living room.

When Mary Jo was seated, Carolyn said, "There's still some coffee left from lunch. You want some?"

"Yes, thanks. I've stayed away from the stove. I guess I'm going on adrenaline only."

Carolyn returned with cups and a coffee pot, then sat down.

"You know, I was thinking about what you said, about being a stirrup holder."

"Oh?"

"It is rough, just sitting here and waiting for news, either good or bad. Our men at least know how they are, and they don't have to worry about our safety back here."

"Well, I guess we could become test pilots too. Then someone else could sit back here and worry about us."

"That's not the point," Carolyn burst out. "I don't want to be a test pilot. I want to be a homemaker."

"Then like it or not, holding the stirrup is part of the job. A couple of generations ago, though, people thought that equality meant having women do what men do."

"I've read about that. They devalued families. And when we let our defenses down, and our enemies pushed us into a war, they drafted women. In the name of equality, as though women were interchangeable with men."

"One of my history teachers was one of those," Mary Jo replied. "A lot of women were killed in combat. That should have been expected. A lot of women were captured. That should have been expected, too. My teacher was one of the prison camp survivors. According to her, the treatment the women prisoners received made the prison camps of Korea and Vietnam look like picnics by comparison. And that should have been expected, too."

"I've never met anyone who went through that. I've just read about it. But the horror of putting women in combat is just a symptom. The real problem is treating women as though bearing children and making a home are of no importance at all."

"True. The country learned the hard way that the family is the foundation of society. If the family doesn't mean anything, there's nothing worth fighting for. At rock bottom, families and homes are the only things worth defending."

"Okay," Carolyn replied, "we're worth defending, and our husbands are out there preparing to defend us. Then why can't we have the kind of family life our men are defending?"

"I wish I had an answer to that, Carrie. I wish someone could tell me why Tom had to die so the people Earthside could sleep easy at night."

She rose to leave. "Thanks for the coffee. I'm not sure I've helped to cheer you up, but if you need anything, call me."

Oh Hallelujah, Oh Hallelujah,
Throw a nickel on the deck,
Save a rocket pilot's neck.
Oh Hallelujah, Oh Hallelujah,
Throw a nickel on the deck and you'll
be saved.

The deck was a long way down, Mike told himself, but if he had a nickel, and dared to open the canopy, he'd throw it. But barring that, he had to save himself.

He was still in a re-entry trajectory. Without rockets, he couldn't circularize his orbit. There wasn't time for an in-space rescue before his trajectory took him back into the atmosphere. He had to bring his stricken craft to a landing somewhere down on the surface. Was there any chance of bringing it down on land, or would he be forced to ditch in the ocean? And even if he could bring it down on solid ground, could he find a level place to land, or would he find himself among mountains, ice pack, or sand dunes that would smash him to bits?

The first thing was to find out where he was and where his craft was taking him. He switched the cockpit display to the Flight Path Indicator. According the display, he was heading southeast over the Indian Ocean. His path would take him to the South Pacific. Then after apogee his ground path would be northeast across the equator. He'd re-enter atmosphere southeast of Hawaii. His projected path would cross the California coastline just north of Oxnard. It would pass just south of . . . *Edwards Flight Test Center!*

Hope surged through him. Edwards had mile after mile of smooth dry lakebed. He'd practiced unpowered landings there many times. If he could get there, he could land safely. If! Could this clunker glide that far once it re-entered?

A thought struck him. Only the starboard rocket nozzle was damaged. Was there some way to fire the port engine only? Both engines were throttled together. Normally that made sense. One hing you didn't want in space is asymmetric thrust from the rockets. You'd end up spinning around the yaw axis. But if he could get down into thick enough atmosphere to give the control surfaces some bite, he could roll the craft, alternately flying erect and inverted, and the asymmetric thrust would imply result in the craft zig-zagging. In act, that corkscrew motion he'd undergone right after the accident would be perfect to cancel out the effects of asymmetric thrust.

In his mind he went over the manuals nd the system diagrams he'd studied meticulously before even getting into he cockpit. No. There was nothing he ould do from inside the cockpit to disonnect the starboard rocket engine. It had never occurred to the designers that someone might want to fire only one engine. Just like Apollo 13. The electric power busses in the two modules operated at different voltages. It had never occurred to anyone that some day a crew might need to power one of the modules from the batteries in the other. The engineer half of his mind noted that as one more change that should be made to the SF-83 before the Service accepted it. Separate throttles for the two engines. But that was no help right now. If he didn't get back to make his report, someone else might later be killed by the same design oversight.

He started to catalog his problems. Weak radio. No thrust. Starboard elevator jammed in the up position. He wiggled the controller and looked out at the starboard wing. Inboard aileron on the starboard side had only limited motion. Outboard aileron slaved to the inboard. Anything else wrong? Not that he could think of. He had plenty of oxygen to breathe, and plenty of electric power left in the batteries. But he had only limited control of his craft about the roll and pitch axes.

He wondered if he'd finally run into what test pilots called the N+1 problem. Any given test pilot could handle some number N of problems at once. The better the pilot, the bigger his value of N. But in the back of their minds they all dreaded the day they would run into N+1 problems at once, and things would come apart for them. The only thing he could do was try, and hope the problems he encountered wouldn't exceed his value of N.

Of course there was another problem about which he could do nothing. There was no way he could make it back for the party Carolyn was organizing. If things had gone right, in another couple of hours he'd have been back on the carrier, with megabytes of data about the SF-83's performance. Now he was going to be late. If he made it at all.

Missing the party would get Carolyn

upset. And not for the first time. He'd had to make a test flight on Susan's first birthday. That had caused a certain amount of unhappiness. He didn't think the unhappiness was reasonable. After all, if he'd been a truck driver or a merchant seaman, there would be times when he'd be away on birthdays or holidays. Why get up upset because his job had some rigid schedules? He had to fly when the test instrumentation was available, and it was pretty tightly scheduled. But the unhappiness had been there.

Things had never come to an out-and-out fight. There was an unspoken agreement never to fight before he went on a flight. They both knew there was some non-zero risk he wouldn't come back, and neither wanted that to happen after a fight. Moreover, a fight might upset him enough to endanger his safety.

But it wasn't just the fact he'd miss the party. Already the word would have gotten back that he was in trouble. Carrie would be worried more about that than about the party. Was there some way he could get word back about his status?

He reached for the radio and switched channels.

"Pacific Control, this is U.S. Space Service flight Alpha One Niner Oh Two. Do you read me?"

No answer. He repeated the call several times. Still no answer.

He thought, my signal should be routed through a satellite, even though I'm a long way from land. That missile rack must have damaged the satellite antennas as well as the elevator and the rocket nozzle. I got through to Africa Control only because I was right on top of them.

He decided to keep calling at short intervals. Sooner or later he'd get close enough to someone to be heard. In the meantime he had immediate problems to deal with.

Once he re-entered atmosphere, he needed to stretch his glide as far as possible. That meant reducing weight. The missiles in the outboard racks were useless now. Suiting action to thought, he dropped them. Then he thought, with his rockets not working, the fuel and oxidizer in his tanks were simply dead weight. They could be dumped. But he had better wait until after re-entry to do that. If he did it now, he'd be surrounded by a cloud of mixed fuel and oxidizer. Not a good idea. Even if they didn't react out here, when that big dollop of fuel hit the atmosphere at re-entry velocity, there would be fireworks. He didn't want to be in the middle of the show. Wait until the atmosphere could strip the stuff away from him as fast as he dumped it, and keep the flames behind him.

The phone rang. With a heavy heart Carolyn walked to it.

"Hello."

"Mrs. Sweeney, this is Colonel Harris again. I'm calling to keep you informed. Mike's chase plane tracked him on radar as he re-entered the atmosphere, then there was a huge fireball just as his plane dropped below the horizon. I don't know what that means, and we haven't heard any more. The chase plane is stil trying to spot him. I'll let you know when we have more information."

She found her voice and managed to choke out, "Thank you, Colonel" then hung up.

There are no rocket pilots down in Hell
No, there are no rocket pilots down in
  Hell.
The place is full of clowns
Who need air to fly around
But there are no rocket pilots down in
  Hell.

Mike Sweeney was now dependen on air to give him lift, and he didn't like it. He had proven he was a hot rock p lot. Put a big enough fan on a barn doo and he'd fly it around the world. But, h told himself, by all the patron saints o pilots, if he pulled this landing off, h was a full-fledged member of the Exal ed Order of the Smoldering Boulder.

The air was getting thick enough that his control surfaces would bite. The jammed elevator was starting to give him a slow roll to starboard. For the moment it didn't matter, except that it was kind of disorienting to see sky and ocean go by alternately. But he had to take out that roll somehow, or he couldn't fly to a landing. He couldn't use the ailerons to counter the roll, since on the starboard side the inboard aileron was damaged, and the outboard aileron was slaved to it.

Wait! If he could switch the inboard ailerons over to the flaps mode, that would unslave the outboard ailerons so he could use them for roll control. Could that be done at this altitude, or was that mode linked to the pressure altimeter, to be used only for landing? He reviewed the control diagrams in his mind. No, he could switch to flaps mode at any altitude.

Okay, he thought. Switch to flaps mode, but don't deploy them yet. I don't need the lift right now, and I certainly don't want the parasitic drag that would come from them.

He then used the ailerons to add torque to the left. That canceled the effect of the jammed elevator. But the deflected control surfaces increased the drag on his craft. That would shorten his glide. No help for it.

He read the rate of descent from the radar altimeter. The California coast appeared at the far limits of his mapping radar. He did the math in his head. He could just barely make it. But making it was important. His craft had to be brought back intact, or someone else might be killed trying to discover what the problem was. Someone who wasn't quite as skilled a pilot as he was.

On one level of his mind he had no doubt he'd make it back. But on another level, he realized that within an hour, Carrie might be a widow and Susan without a father. They both deserved better than that.

He reflected that he had come a long way from the boy who looked up at the clouds. He'd climbed to the very top of the aviation pyramid. But along the way he'd made some other commitments. Maybe it wasn't fair to ask Carrie and Susan to live on top of the pyramid with him.

He tried the radio again. This time a weak reply came back.

"Service Oh Two. We read you, but your signal is weak. We have been informed that you declared an emergency over Africa. Is the emergency still in effect?"

He couldn't restrain a bitter laugh, even though his mike switch was open.

"Say again, Oh Two."

He got himself under control. "Yes, the emergency is still in effect. I have practically no control over this thing. Can you clear me to Edwards?"

There was a pause, then the reply.

"Roger. You are cleared to Edwards."

"My satellite radio is out. Can you patch me through to Edwards tower?"

A few seconds later a different voice came on. "Service Oh Two, this is Edwards tower. Over."

"Edwards, this is Service Oh Two. I need to make a dead-stick landing. I'll be coming in hot. Can you clear me in?"

Yet a different voice came on. "Service Oh Two, this is the duty officer at Edwards. The coastal mountains to the west of us are about 1,500 meters high. Our radar shows you dropping pretty rapidly. Do you think you'll have enough altitude to clear them? Over."

Sweeney checked the radar range to the coast, compared that with his rate of descent, and came to an unpleasant conclusion.

"Edwards, this is Service Oh Two. It will be very close. I'll be scraping the mountain tops. Can you suggest any alternatives? Over."

"Afraid not many, Oh Two. There's bad weather off the coast. If you ditched there it would be hours before we could get a helicopter out to you, and the seas are running pretty high. Even in your ejection capsule you'd likely be swamped. About all I can suggest is that you come in over the coast, head your plane back out to sea, and eject while you're still over land. Over."

"That won't work, Edwards. This thing needs a hand on the stick to control it. It might well crash on land somewhere."

There was a pause. The Edwards duty officer understood that no pilot would willingly risk innocent people on the ground with an uncontrolled airplane.

"Besides," Sweeney continued, "I need to get this thing back intact so the failures can be analyzed. Over."

"Understood, Oh Two. You are cleared for a dead-stick landing. Be careful of the reservoir as you come in. It's a trap. It's in a valley, but there's a high mountain wall on the far side. Don't try to fly down that valley. Over."

He remembered that reservoir. It would be a trap to fly into that valley. "Thanks for the warning, Edwards. Please inform Grissom Station of my situation. And look out below. Out."

Carolyn Sweeney hung up the phone after Colonel Harris delivered the latest news.

She thought, so Mike was alive and on his way to Edwards. She remembered Edwards. They'd spent a year there while he went through test pilot school. But he wasn't down on the ground yet.

She remembered one of Tom Harper's jokes. About a man who fell off a ten-story building. As he passed the fifth floor someone asked how he was. He replied, "Okay so far." The joke was typical of the gallows humor the pilots used to keep their fears at bay. So Mike was okay so far. But if he had to land at Edwards, there was something wrong with his plane. That didn't make the landing sound routine.

On top of Old Baldy,
All covered with snow,
Lies an old rocket pilot,
Who was flying too low.

As his craft crossed the coast, Sweeney's radar showed him already below the highest peaks.

Got to thread my way through them, he told himself.

He remembered something he'd been told in test pilot school. A crash is defined as running out of airspeed, altitude and ideas all at the same time. Not much he could do about altitude and airspeed. He'd need to have as many ideas as possible.

The town of Oxnard quickly went by on the right. Then the mountain ridges were below him.

Sulphur Mountain passed by below his left wing. The display showed it as just over 900 meters high. He was still above that. Then came Sulphur Peak, at 1,200 meters. Closer, but he was still above it.

He just cleared Townsend peak. From now on he was down among the peaks. He had to weave between Sawmill Mountain and Sawtooth Mountain. He banked as little as possible, to keep from losing any more altitude than he had to.

Then he was headed directly for a mountain that towered above his altitude. The valley with the reservoir was to the right. He had to take the valley to the left.

Bank to the left to get around that mountain.

Can't bank to the left. I'm using a lot of aileron just to keep this thing from rolling to the right.

Then let it roll three-quarters of the way around. Reverse the ailerons so it'll roll faster. Wait until it comes around, then catch it at the right bank angle.

Okay, now use the ailerons to null out the roll, and pull some *g*s.

The mountain seemed close enough that he could reach out and touch it, but he cleared it.

Another mountain was coming up

ahead, as the Mach-meter dropped to Mach One.

Another problem hitting me, he thought. I'll lose some control as I drop through Mach One.

There was a sharp bump as the Mach-meter dropped to 0.98. He took a quick glance at the wings. Shock waves were rippling like spiderwebs across the wing surfaces.

The elevators decrease in effectiveness for a speed range just below Mach 0.97, he told himself. Got to take out some aileron, or I'll over control for that jammed elevator. He held the ailerons at neutral. As the Mach-meter dropped a bit more and the elevators regained their effectiveness, the craft started rolling to starboard. He cranked some aileron back in to compensate. Buffeting set in, rattling the entire craft. He rode it out until it ceased as he dropped below Mach 0.88.

He'd managed the passage through Mach One, but it had taken his attention away from the mountain that was now directly ahead of him.

Head for the lowest point in the ridge, he thought. Got to trade airspeed for altitude. Pull the nose up. He started to gain altitude, as the airspeed indicator dropped.

Not good enough, he told himself. If I pull the nose up any more I'll stall, and at this rate I'm not going to clear the ridge.

Wait! The attitude control jets. They're for use in space, where the control surfaces don't work. But no reason they can't be used in atmosphere. Hit the nose and tail belly jets at the same ime, and they'll give me some additional boost. He mashed the buttons down, holding them until the jets ran out of uel.

Slowly his craft rose as the distance to he ridge shrunk. He passed over with what looked like only centimeters to pare.

Then he was in the clear. Off to the ight was the town of Lancaster, on the valley floor seven hundred meters below him. To the left was the vast expanse of Edwards.

Now that I'm past the mountains, he told himself, I've got to get rid of airspeed and altitude. Can't just dive down. That'll bring me in too fast. Got to spiral down, bleeding off airspeed.

He set up a spiral descent just to the south of Edwards. He intended to come in from the south and use as much of the lakebed as he needed to come to a stop.

He recalled the flight manual for the SF-83. In clean configuration and with full flaps down, he told himself, this thing lands at 200 kilometers per hour. But dirtied up like this, with control surfaces sticking out every which way, and with only partial flaps, God only knows what the stalling speed is. Better figure on coming across the fence at about 250 kph.

He carefully watched both altitude and airspeed as he spiraled down. Finally he reached a decision.

Airspeed is a little higher than I'd like, he told himself, but I don't have enough altitude to make another turn. Got to land, even if I'll be coming in pretty hot.

He rolled out of the turn, leveled the wings and headed for the airfield boundary.

Drop the landing gear.

Bleed off the airspeed.

Keep the nose up, just below the stall attitude.

Got to get the speed down. Don't dare land hard enough to collapse the landing gear, or the belly landing will wipe out whatever evidence is left of the missile rack problem.

Nose-high . . . wings level . . . nose high . . . keep it straight . . .

Suddenly he felt the ground-effect air cushion below the craft.

That's it, he thought. Got to level off now and land, or I'll drag the tail and crash down.

THUMP!

He bounced once and was down. He

applied the brakes gently, so as not to risk burning them out. With agonizing slowness the speed dropped. A roostertail of dust billowed behind him. Finally the craft came to a halt.

Suddenly he was aware of the sweat pouring down his face, and soaking the armpits of his flight suit. He opened his faceplate and took a couple of deep breaths.

He keyed the microphone. "Edwards tower, this is Service Oh Two. I'm down."

An unfamiliar voice came on. "Congratulations, Oh Two. This is the Center commander. That was a damned fine piece of flying. We'll send a tractor to tow you in."

"Thanks. And let Grissom Station know I made it."

"Roger."

Yeah. Let Colonel Harris know, so he can send a courier flight to bring me back. And let Carrie know I made it safely through a test flight one more time.

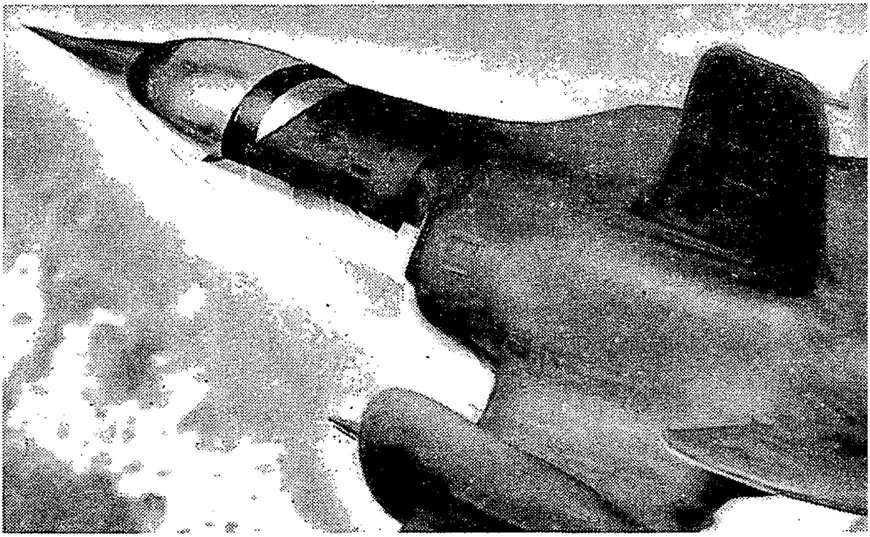
But how many more times, he asked himself, am I going to put her through this? How many more times am I going to risk meeting the N+1 problem?

In flight training, the fighter pilots told me that unless you were one of *them*, you were nothing. So I had to be one. Then the rocket pilots told me that unless you were one of *them* you were nothing. So I had to be one. Then the test pilots told me that unless you were one of *them* you were nothing. So I had to be one of them. Now what? When we start flying to the planets, will the space pilots say that unless you're one of *them* you're nothing? And what about when we get starships? Every time they add a layer to the pyramid, do I have to climb that one too?

When I was a kid dreaming about flying, this wasn't what I had in mind. I didn't go through aero engineering and flight training to prove something. I did it because I thought flying would be fun. I've lost sight of my original goal.

Regardless, I have proven something. I've just flown my way out of a problem that would have killed probably half the pilots in my squadron. I've proven I have what it takes to be a test pilot. Now do I have what it takes to do what *I* want to do, instead of what a bunch of rocket jockeys think I ought to do?

With that he began composing a letter to Colonel Harris, requesting a transfer back to a fighter squadron. ■



For some problems,
past experience isn't much of a guide. . . .

Hullabaloo

Diane Turnshek

The Town Council meeting was split down the middle—the Hullabaloo colonists on the one side and Fenella Elane Tyne on the other. Jerram stood in the back and admired the way Fenella strove to convince the tired farmers. Pacing around the podium, she brought to bear the power of unmatched intelligence, impeccable honesty, and polished verbal skills. In the discordant discussion that followed, Jerram studied her serious face. She was magnificent, but hopelessness coursed through him. She didn't have a chance of winning anyone over to her side. And he didn't stand a chance of winning her.

A red strobe light cut through the hall. Immediately the crowd silenced. From his position at the back of the dome, Jerram unsealed the soundproof hatch, giving entry to the very last of the colonists, workers, and their families from Loose Lips Ridge. He purposely held the door open wide while the stragglers quietly found their seats and removed their earplugs. It was the least he could do for Fenella; the loud, random outbursts they heard through the doorway were on her side.

"Hey, Jo, give me a hand with this." "Oh, shit!" "What's that noise?" "Why are you doing this?" "But, Mom—" "Show yourselves!" "Look at those little creatures." "Achoo!" "Oh, shit!" "Be careful, Jerram." "Look at those little creatures." "What's that noise?" "Hey, Jo, give me a hand with this." "Achoo!" "OOOooooo" "Show yourselves!" "Who are you?" "Be careful, Jerram."

Patches of brilliant blue, green, and gold fur decorated a small animal that crept up to the door as if to spy on the meeting. Jerram ignored it. As uncomfortable as he was in the spotlight, he hesitated until all eyes in the room were on him. Then, moving with studied precision, he forced the hatch closed, sealed it, and redraped the soundproofing patch. Then he faced Fenella, transferring all the attention he had garnered to her. Fenella stared hard at the colonists before speaking again.

"Do you want to listen to *that* every day of your lives? I dare you to try it tomorrow! The noise level of the mimers has increased in the months we've been here, with no sign of forgetfulness on their part." Fenella punctuated her points with finger stabs at the household leaders. "Even with the Shush Laws, at the rate they're picking up our occasional dropped word, this glorious planet will soon be a cacophony of copied voices, unable to support a sane, intelligent, hearing population. Avoidance of speech is not the way. We must act!"

Jerram had to break up several fights during the "discussion" that followed. Weary muscles made for frayed tempers. "Show yourselves" Blazon and "Achoo" Chelini were booed whenever they tried to speak. People were simply sick of hearing sounds from their mouths. The speakers in the parade that followed each had their own reasons for ignoring the mimer problem.

"There are too few of us left. Where are we supposed to find the time and energy for research?"

"They're too beautiful to hurt and you can't study them without disturbing their lives."

"Let's deal with issues important to the success of the colony first."

The voices were different, but, to Jerram, they all translated to: "No, Fenella." As point after point went against her, Fenella's beautiful face set into a stubborn frown.

It was Jerram's duty to sum up the meeting, even though he didn't want to. His elevated status as the quietest one among them gave him power he hadn't sought and didn't feel comfortable exercising. Beyond that, speaking around Fenella always made him tongue-tied.

"I caution you to have patience, Fenella." Jerram's midsection knotted with tension. In an effort to get his speech over with quickly, Jerram gave up searching for a tactful way to cram his summary into a single, polite sentence. "We appreciate your willingness to bring up this issue." He balked and Fenella grabbed at the chance to interrupt.

"I can't live like this," she said. Her breathing sounded labored. "I've told you all I've learned about the mimers, which isn't much, but how can you not want to learn more? You're all living in a dream world!" Her voice cracked with emotion. "Patience, Jerram? *Patience?*"

"The mimers are an, um . . . unfortunate aspect of this planet." Jerram looked down, then around the dome, anywhere, but Fenella's face. "We will deal with them in our own time. Shush Laws stand. Mm . . . mm . . . meeting adjourned."

Jerram found himself being hustled by the crowd to Fenella's side. A precious moment of intense eye contact was terminated abruptly as she slammed the strobe light button. His love for her was unspoken again. Unmindful of the glaring looks as people were forced to truncate their sentences in the middle, Fenella yanked the hatch open and strode stiff-backed into the night.

The next day, Jerram decided to take Fenella's challenge to work without earplugs. The mimers' jewel-colored fleece stood out clearly in the scrub forest surrounding his fields. They held their tails high, the resplendent plumes and trailing feathered puffs bouncing as they swung in the branches. The dazzling streaks of blue and gold were radiant against the tangled gray Hullabaloo vegetation. Jerram, like everyone else, instinctively reacted to them as animals of value, just on the basis of their looks.

Their voices mocked him as he primed pumps, sluiced fields, and hauled terran ag bales. The racket followed him from job to job, never letting up, never letting him think. The clamor of the colonists' initial reaction and their unthinking spoken understanding paced crop rows with him. Sigma Draconis was high overhead when Jerram took his first break—a sit-down job mending UV-flux-damaged panels.

One mimer scampered down and perched almost within reach. Jerram's nose itched. He breathed in deeply, trying to catch the mimer's scent. Nothing The damp, rich, Terran-modified soi and his own sweat came back to him but, from the mimer, nothing. Its luminous eyes tracked his every move.

"Be careful, Jerram." His mother's voice. This one always got to him.

"Who are you?" it said.

Who, indeed, he wondered. Just a guy trying to do his job. When the mime nimicked Roxie's involuntary orgasmic utbursts, he hurled a stone near it, scarng it away, but the echoes around him vere merciless. He threw down his ools, stomped to his flyer, and let the athering wind drown out the piping lin.

The homesteads were set up in piehaped wedges, the farmhouses close to he center. Jerram passed "Oh, shit!" learing and veered left at "But, Mom—" noll. Planetary landfall had been a shodly, disastrous affair with the contingent f scientists bearing the greatest losses. he number of colonists that had surived was miraculous thanks to the hick, springy vegetation they had crashunded onto. Their farmlands, the only ortion of the planet that had yet been xplored, lay near the center of the large outhern continent. The same dense, st-growing brush that had saved them as now damning them to farming hell.

Even with his slow, short-hop flyer, it idn't take him long to reach his cabin. e had hoped that one day it would not e his cabin alone. He had thought of enella with each beam he had put in lace.

Fenella was waiting for him outside is front door. Surprise almost made him lurt out her name, even after all the onths of practice. When it came to reaking the Shush Laws, there was no oubt who had committed the crime. limer betrayal of the transgressor was stantaneous and the evidence was onveyed like spreading ripples in a ond. Fenella had clocked the transferal eed at nearly eighty kilometers per our.

In the bright sunlight on his porch, er loose, draped garment of sheer pasl rose didn't hide any of her body's feaures. Her nearness made his breath tch. Desire rose up in him; it wasn't e first time in her presence he was ad he wasn't allowed to speak. What ould he say? Signing for her to come side was easier than words would ve been.

She refused.

They stood on the porch, looking at each other. Jerram signed a question mark in the air between them. She looked determined and pointed at her sleek black flyer parked by his door. Extending her hands out in front of her, palms down, she swiftly closed them to fists. Jerram recognized the sign for leaving. But, leaving what? Unlike the youngest members of the colony, his sign language ability was slow to grow. He gently took her arm and guided her into his cabin. She chose to stand in the center of his kitchen.

Facing him squarely, she said, "You caution me to patience and I have none left to give. You offer me no hope of a better future." She rubbed her arms with callused hands, tears forming in the corners of her eyes. "I cannot bear it any longer, Jerram."

He ached to take her into his arms, but how could he if he didn't agree with her? He tried instead to keep her talking, hoping that somewhere in their conversation they would find common ground. "I thought I came to terms with the voice of mm . . . my . . . mm . . . mother months ago, but today, hearing her so clearly without the plugs . . . it was hard to take."

She gave him a sad smile. "You went without earplugs? I'm sorry, Jerram. I miss her, too. But, think of this—what if the mimers are sentient beings? What if they advocate using nonviolent means to drive invaders from their homeland? We have so little data to go by. Do they tell you to "Be careful, Jerram" more than they tell that to the rest of us? I don't know." She paced up and down in the constricted space. "I could catalog Hullabaloo plant types into the millions; why are there so few other animals? I'm sure the mimers didn't *annoy* them all to death. Is the mimer's ability used to confuse predators? Or, maybe that's how they lure prey into their midst. I *need* to understand."

"And you will. The others will come

around. Soon. You'll see." Jerram began to pace alongside her. "Just let us get the crops harvested and the ruster problem dealt with—"

"No! I'm not waiting. Don't you see what I'm really up against? It's fear. Ignorance! The colonists don't *want* to know what's going on. That's why I'm forbidden to make sense of this new world. And you, Jerram, you are as stubborn as the rest of them. How long would I have to wait till you came around?"

Her challenge hung in the air between them.

"I'm leaving," she said with finality.

Jerram froze, his mind in turmoil. "Leaving?" he echoed, unmindful of his social faux pas. Through her words, the very alienness of the planet reached him. She was right. As long as they all pretended the mimers were just an annoyance, a small price they had to pay to live here, it was bearable. Her agitating had brought out a stubborn streak in the colonists the likes of which he'd never seen. If only he could talk freely with her . . . but the words wouldn't come out.

"Leaving?" he mimed.

"Oh, Jerram . . . I'm leaving the safety of the colony. I'm heading out alone to study them in their natural habitat. If I don't make it back, just know that I love you."

Then, she kissed him.

So unexpected was it, his head hit the wall behind him. Off-balance, he clutched at her, his hands finding purchase on soft curves. It was too much her warmth, the pressure of her body leaning into his, and the flowery scent of her loose hair. The overwhelming sensations damned him to motionless Fear kept him from responding lest he turn the moment. He was still reeling when her teary "Goodbye, Jerram" reached him, and then she was gone.

By the time he staggered through the door after her, the black flyer was a dwindling speck above the trees. Without earplugs, he felt challenged by the suddenly alien mimers.

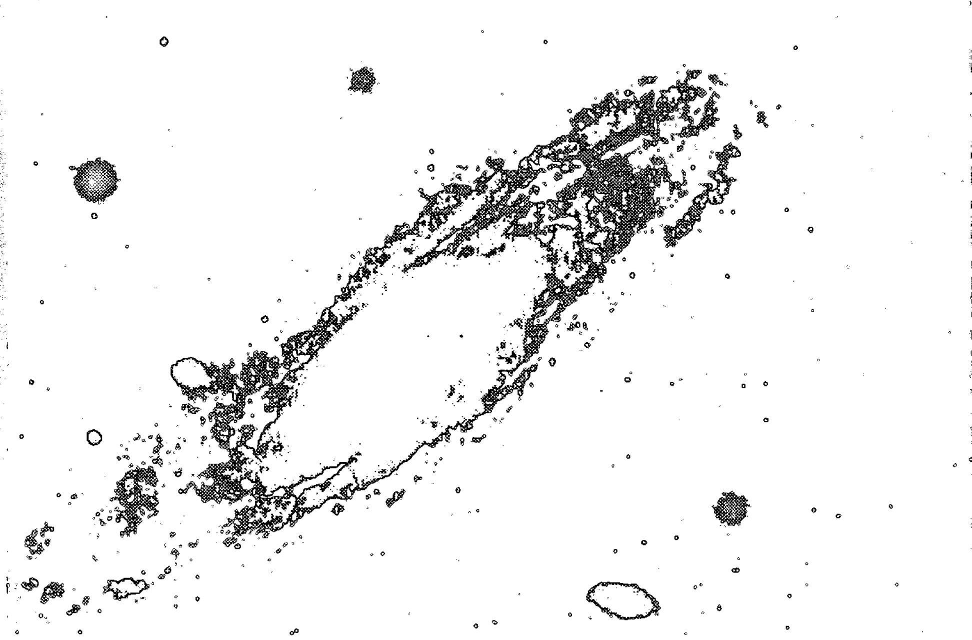
"Watch out!" "Be careful, Jerram." "Oh, shit!" "Who are you?" "Why are you doing this?"

Jerram climbed into his flyer. It didn't have the speed or the range to follow her. He feverishly fiddled with the controls. She didn't respond to the visual radio. Of all the future paths he had imagined their lives taking, none included her disappearing alone into the unexplored wilds. Fearing for her life, he raised the flyer to the roofline of his cabin. With a heart-pounding leap, he wa standing, balancing on the apex. There was only one way to save her. For Fenella. For posterity.

Gathering all his courage, he shouted from the rooftop, "Fenella, I love you!" ■

The progress of rivers to the ocean is not so rapid as that of man to error.

— Voltaire

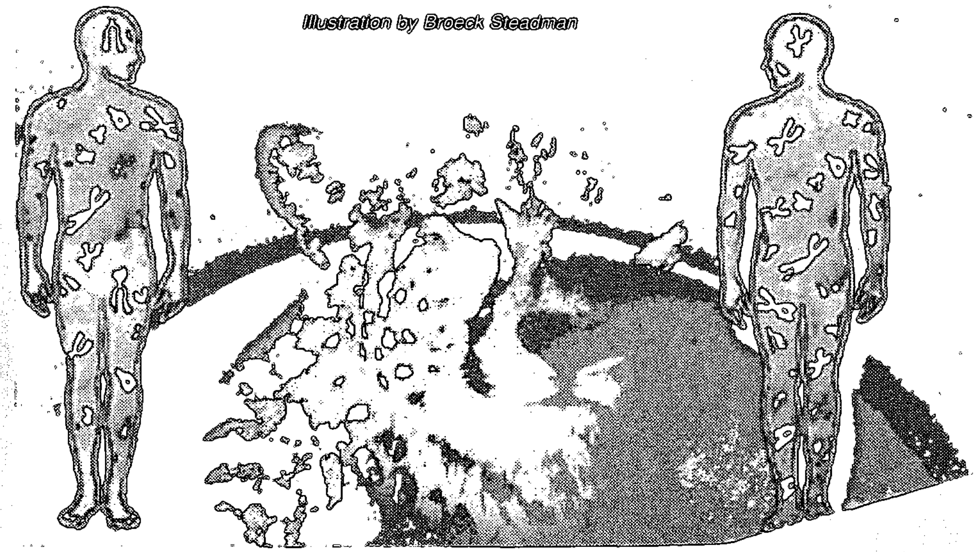


CHEETAHS

Robert R. Chase

Given the costs and delays inherent in interstellar travel, what kind of trade could make economic sense? Something you literally cannot live without, of course. . . .

Illustration by Broeck Steadman



1.

There are no thoughts, no reveries, no musings in cold sleep. All the experts agree on this. With all the blood sucked from your veins and your body temperature at -10 degrees Centigrade, there is, there can be, no electrical activity in the brain. There is nothing but frozen colloids wrapped in bone.

The dream is a cliché from the earliest days of the Diaspora. Everyone immured in the catacombs has experienced it one time or another. Some experience it every time. His body frozen, his soul floats through the metallic wall of his capsule, through the bulkheads separating the catacombs from the rest of the vessel, and out into the depths of space. He views his former home without emotion. It is shaped like a huge metal funnel, decorated with a baroque assortment of hatches, flanges, antennas, and exterior piping.

Fire leaps from the end of the narrow shaft, a beam too brilliant to be looked at directly.

Impossible! In a vacuum, you can't see from the side the energies released by matter-antimatter conversion. Perhaps this should not matter so much in a dream—if you could dream in cold sleep.

The starship begins to move, slowly at first, then with ever-increasing speed. He realizes abruptly that his body is leaving him behind. Without it, he will drift forever in the darkness. He tries to propel himself after it by sheer force of will. Surprisingly, he can. But not fast enough. The starship accelerates beyond him, dwindles in the distance, and disappears.

"Captain?"

So any dream must occur in the last seconds of consciousness, as blood is being replaced by rubber cells and fluorocarbons. Or during resuscitation, as the body welcomes back its own blood and warms painfully to life.

"Captain Hendricks?" A light dazzled first one eye, then the other, leaving afterimages of retinal capillaries. He tried to respond, but mouth and throat both seemed to have been scoured with coarse sand. A slight groan escaped his lips.

"Do you see my finger, Captain? Please follow it." He did so, remembering that this was part of a well-established pattern. That those parts of resurrection that were not excruciating were always boring.

". . . tracking is normal, nor is there any overt sign of cerebral damage. Now . . ."

He couldn't hear the rest, but caught the concerned tone.

"Captain Hendricks, do you know who I am?"

A face loomed over him like a miniature world. Dark brown eyes and light brown skin. Raven black hair.

"Doctor." Pause. "Juanita. Alvarez." Each word was a victory.

"Very good. Can you tell me where we are?"

It took a few seconds' thought. "In the catacombs."

That brought a frown. Medical personnel never liked that name. It seemed to imply a lack of faith in their abilities.

"And what are these . . . catacombs?"

Someone was sponging his lips. Moisture loosened his tongue.

"The catacombs are the rooms containing the cold sleep capsules. Always located in the center of a starship."

"Why is that?"

"To protect the sleepers from hard radiation." He swallowed and licked his lips. Words tumbled into consciousness. "Travel at relativistic speeds greatly increases the exposure to hard radiation. It is easy to monitor active crew members and clean up these genetic problems as they occur. But in the sleepers, the damage just accumulates year after year."

"Excellent. One last question. Why are we traveling between stars?"

"We are on a mercy mission to the Meji colony." He frowned. That wasn't uite right. A different memory clamred for attention. "Terranova threw us ut. We have been exiled as troublemakrs."

He shook his head, trying to clear it. ig mistake. Pain surged through his kull like the tolling of a huge bell. Through it all, a third answer forced it-elf to his attention. "The Colonial Coun-il is afraid of the *Conestoga.* Of the *Al-ert Schweitzer.*"

"You sound confused," Juanita ob-erved.

"Yes," Lars Hendricks whispered. Fear ose within him. No shielding could be erfect. How many neurons had been ried while he lay frozen? Or had they otched the replacement of blood with luorocarbons, allowing capillaries to upture as they froze, destroying brain ells? They were so many ways the rocess could go wrong. Had gone rong in the past.

To his surprise, Juanita laughed. "Con-ratulations, Captain. You pass all the ests. Your confusion just proves that ou are in full possession of your facul-es."

2.

Lars worked hard to prepare himself r the change of command ceremony at would take place in five days. He ched from the exercise regimen that as slowly restoring strength to his ody. At times, cramps doubled him up s his digestive system adjusted to deal-g with food for the first time in two ears.

In between exercise periods, he ught up on the news from the Inter-ellar Party Line. Reports from Skylan-ia indicated possible contact with an telligent native race, though details of e alleged contact and interpretation of ose details seemed to be a matter of ntroversy. The Galilean colonies had ain been swept by rumors of a way to me the flaring Sun. On Terranova, a new government had declared the crew of the *Albert Schweitzer* to be technology thieves.

This last bit of information had come from second shift Captain Jim Lockerson, who had been thawed out the same day as Lars. "How can they say that?" Lars protested. "They threw us out. They wanted to get rid of the *Schweitzer.*"

Jim shrugged. "Please do not expect me to make sense of politics. Besides, this news is twenty years old. By the time we get back, we may be heroes."

There were a few other visitors, but not Amanda. Long ago he had realized the atavistic origins of the rules they had set themselves, that he would not see her until fully recovered from cold sleep. But, however proud or chauvinistic it might be, he wanted to see her only when he was fully recovered.

Besides, the anticipation itself was pleasurable.

On the fifth day, Lars donned his full dress uniform and made his way to the bridge, where he was greeted by Captain Amanda Connelly. While the rest of the ship's company watched, either in person or on the monitors at their stations, she handed over the small electronic notebook which accessed the Captain's log and contained all the command codes. She then stepped back and saluted.

"Your ship, Overcaptain Hendricks."

"Thank you, First Officer."

"Would you like an inspection tour?"

"Please. Lead on, Ms. Connelly."

He had taken part in this ceremony six times, three times as the retiring captain and now for the third time as the succeeding captain. So far, everything was going according to custom. Despite which, he seemed to sense an underlying tension in Amanda's smile. It might just be crowding. For the first time since launching, the catacombs were completely empty. All three crews were awake at the same time.

Or it might be proximity to Meji, the

reason they had flown across twenty light-years of emptiness, leaving family and friends to grow old and die behind them as they lay in refrigerated coffins. *We've almost done it. We have almost succeeded in what they all called a foolish and impossible mission.*

As always, the first stop was engineering. Sydney Crosswell was at the Chief Engineer's post. Croswell, who had convinced the Colonial Council that the old *Conestoga* could make a flight twice as long as the flight that had brought it from a flaming Earth. Who had personally been in charge of the overhaul of the power supply and propulsion systems. Lars returned his salute.

"Everything fine as usual, Chief?"

Sydney and Amanda exchanged a quick glance. Lars frowned, wondering if he saw resentment or anger there.

No.

Fear.

"I thought you should hear this from Mr. Crosswell," Amanda said. "There are technical . . . issues."

Lars wondered what that could be. From the moment of awakening, he had felt a steady one-*g* deceleration, the product of the hundred-thousand-mile-wide magnetic scoop which was funneling hydrogen into their storage tanks. The original Bussard ramjet concept had not worked out as originally designed, but it made an excellent brake, not just saving but actually accumulating reaction mass.

There had been no alarms since his resuscitation. As he looked around the engine room, all the readouts appeared to be safely within their optimal ranges. Green lights beamed uniformly from all stations.

One blinked yellow for an instant, and immediately became green again.

"The problem is in the mixing bottle," Sydney began. As he touched the console in front of him, a schematic of the propulsion system appeared in the air between them. Two idealized cylinders fed into a third. One turned red as Sydney "touched" it. "The magnetic bottle for the ionized anti-hydrogen." A finger wave suggestive of a conductor cuing the horn section, and the companion cylinder became blue. "Regular ionized hydrogen, replenished as we fly by our ramscoop." Index fingers converged and a third cylinder came into being beneath the first two. "And here is our mixing bottle, its inner surface set to repel antiprotons, its outer shell set to confine regular protons. The protons and antiprotons are fired into the inner chamber where they attract and annihilate each other. So we get total mass-energy conversion to provide acceleration as well as power for the rest of the ship."

He was stalling, Lars realized. It would have to be really bad if he had to work up his courage this way. "Only?" Lars prompted.

"Only in the last six months we have noticed an occasional radiation spike originating outside the mixing bottle." A yellow spark flashed briefly outside the hologram of the mixing bottle. "I'm afraid we—I—ignored the first few incidents, thinking them instrumentation errors or the result of particles getting through our exterior shields. Four months ago I became worried enough to line the interior of the reaction chamber with as many sensormites as I could without interfering with the magnetic field. One of them became inoperative during the first half hour. When I examined it, I found a minuscule crater, a layer of melting, and radiation damage."

"Antimatter?" Lars asked.

Sydney nodded. "Despite the fact tha the beams are aimed directly at each other, despite the fact that the particles are mutually attractive, the shock wave produced is driving some antimatte particles through the magnetic bottle They annihilate themselves on the coil which create the magnetic bottle. A you would expect, that degrades the performance of the field, which allow more particles to escape."

"What is the current field perfor

mance?"

"At present we are still operating at more than 99 percent of standard," Sydney said, "but here is the problem."

The schematic disappeared, to be replaced by an X and Y axis and a curve climbing up against an asymptote. "Right now, we are here." Sydney indicated a point on the curve where it still hugged the X axis. "Our calculations indicate that we will be *here* in thirty days. Or less." He highlighted a point where, to Lars' eye at least, the curve had become a vertical line. Total failure of the mixing bottle.

"Decrease the particle streams into the mixing bottle," Lars suggested. "The magnetic field should be strong enough to contain less energetic explosions."

Sydney nodded judiciously. "It is. However, at that rate the mixing bottle does not produce enough power to maintain both the magnetic fields and the other life support system. Much less enough to provide thrust."

"And there is no way to repair the damage to the magnetic coils?" Lars demanded.

"I would have to do more than repair the damage. I would have to reconfigure and strengthen the fields to prevent the same thing from happening again. I have three work crews available, and most of the work in the reaction chamber can be done by microbots.

"Time is the problem. Working at 100 percent efficiency with no down time (and we both know how likely that is) he task cannot be completed in less han thirty hours. During that time, the ship would have to operate on battery power. I could shut down life support by putting the crew in pressure suits and the two shuttles during the procedure. Even doing that, batteries will not be able to power the magnetic bottles onger than twelve hours. At the end of hat time—boom!"

Lars bit his lip, an unconscious habit eft over from childhood. "The arkship which carried the Mejan colonists was still in orbit and operational, the last I heard. If they can run a line from their reactor to our engine room, we should have enough power for repairs and sustainment of the containment fields.

Amanda grimaced. "That brings us to our second problem . . ."

3.

Terri Lee did not look like a gadfly, much less a revolutionary. Clothed in a shapeless one-piece coverall, hair androgynously close-cropped, she looked to Lars more like a Chinese mother who had worked all day in the factory and would now call all her daughters, worried about how they were getting on with their husbands and children. You would not immediately recognize her as the foremost immunologist of her generation. You would not suspect that she had become such a thorn in the side of so many governmental officials that they given her a starship and a crew just to get rid of her.

Yet from the moment the distress call from Meji had been received, Terri Lee had been in the forefront of the relief effort. It had been known well before the first arkships launched that domestic animals such as pigs and poultry could serve as hosts for flu strains. Yet it never occurred to the bio-techs who genengineered their protein stocks that meat grown in the vats could carry similar viruses. Ten years before receiving the first Mejan distress call, Terri had traced an epidemic ravaging the Terranovan colony to workers culturing chicken meat. As she perused the reports from Meji, she became convinced that, even if this was a different virus, it was being spread the same way. She prepared the procedures for isolating the virus and preparing a vaccine. Yet even as she transmitted her data, the quality of the reports from Meji changed. Medical data became sparse. The narratives stressed quarantines and other civil remedies. Reading between the lines, Terri became convinced that most medical personnel must have already succumbed to the disease. It seemed not unlikely that when, in twenty years, her reply was received, there would be nobody left alive to use it.

Matters might have ended on that unsatisfying note but for the political instabilities of the Terranova colony. Epsilon Eridani was roughly four billion years younger than Sol. A K-type orange dwarf, its habitable zone was correspondingly smaller than that of the Sun. Terranova's pronounced elliptical orbit brought it inside that zone for a short, intense summer and swung it out beyond the zone during the long winter period. Save for the fact that there were lava seas nearly as extensive as the water seas, the planet might have fallen into a permanent deep freeze. On those nights when the wind blew away the ash, the sky would be filled with meteorites. Sometimes you could feel the ground shake from an impact.

A harsh world. A dangerous world. Watching the mottled surface of the star and the flares caused by its fast rotation and strong magnetic fields, many of the colonists were forcibly reminded why their parents had to leave Earth and were not comforted. Although the project to seed the water seas with oxygen-producing microbes was well ahead of schedule, it would be two hundred years before there was sufficient oxygen to make the atmosphere breathable.

And every clear night they could see, moving high overhead, the starship which had brought their parents to this world. They wondered if life would have been safer had they decided to mine the Oort Clouds, as some refugees had done, or create O'Neill habitats to bathe in the radiation of A-type stars like Sirius and Procyon. There were even some enticed by the notion that Earth might not be seared rubble, and that it could be possible to return. The presence of the *Conestoga* in orbit was a continuing reminder that the choice made by their parents was not, perhaps, irreversible.

The majority of the Colonial Council found this attitude counterproductive. Some considered it actually dangerous and even traitorous. Making a go of it on Terranova was going to call for single-minded dedication. You couldn't have people every few years being tempted to give up and go elsewhere.

Council members noted as well that it was the technically proficient among these malcontents, those who kept alive the skills to fly the starship, who most often alleged that projects supposedly designed to increase the comfort and safety of the colonists had a higher likelihood of increasing the wealth and influence of council members, their friends and family.

Terri Lee was by no means politically astute. Despite this controversy and the fact that Terranova was still a small colony, she was still surprised when she was visited by a three-man delegation from the Colonial Council. She was dumbfounded when they informed her that they would put the *Conestoga* and a crew to fly it at her disposal, and that it would be fitted with a fully equipped medical laboratory.

That evening, 500 other colonists received similar offers, some with the slightest hint of a threat. Many declined. Enough did not that within a year the newly refurbished and rechristened *Albert Schweitzer* swung out of orbit and began its journey to 61 Cygni. At the end of its journey, the ship would be able to provide complete medical care to the entire Meji colony. If anyone were still alive.

"You are telling me that everyone is dead?" Lars demanded. It had been the nightmare in the back of everyone's mind since leaving Terranova. The fligh would take fifty standard (meaning, Old Earth) years. In the meantime, it could become futile in either of two very different ways. With continued radio assistance from the *Schweitzer* and the othe colonies, Meji could rebuild its medical care infrastructure to handle the problem on its own.

Or everybody could die.

"I am not telling you that." Terri rubbed her forehead wearily. "I am telling you I don't know what has happened. Until five months ago we were in regular contact with the colony. I was dealing with a young man named Toshiro Hama. He was very personable, interested in everything we could provide to him, not just about medical procedures and rebuilding their infrastructure, but also about the Interstellar Party Line and stellar culture generally. Apparently the Sensei have cut off most access to those broadcasts."

They sat across from each other in the captain's conference room. Amanda was at his side. On the other side of the table, with Terri, was Tom Springer, chief of the astronomy/navigation sections.

Lars bit his lip to restrain his impatience. There was no way to tell what might be the crucial clue to this sudden mysterious silence. And it was odd that the Interstellar Party Line—the broadcasts from every colony with the ability to transmit to every colony with the ability to receive, consisting of the daily news of the colonies as well as their arts and those things most valued which hey had managed to take from Earth—would be prohibited.

"Was there any indication of a renewed outbreak of flu?" he asked.

Terri shook her head. "No. I was hoping that this might be the time we broke he five-year cycle. Every succeeding outbreak since the first has been weaker han its predecessor. As one might expect, a natural immunity has been developing. Also, I think our instructions on quarantine and sterilization procedures have had an effect."

"So they simply ceased transmitting without any explanation, without even a int that something might be wrong."

"I don't know. I have been reviewing the last two weeks worth of tapes. Sometimes Toshiro looks worried in a way that has nothing to do with the subject under discussion."

"Which is?"

"Robotics. Automation algorithms. The sort of thing they have been interested in for the last thirty years."

Lars nodded. "Anything else?"

"Once or twice he alludes to frictions with the Sensei. He ends his last transmission with the statement that there are some local matters that need to be cleared up. Then nothing."

Lars looked over at Tom Springer. "Can we tell anything from direct observation?"

"We are still more than five light-hours away," Tom said reproachfully. An image appeared in the space between them: 61 Cygni A2, a jovian gas giant. Off to one side orbited a globe midway between the size of Mars and Earth. Only half the globe was illuminated in this image. Beneath sparse cloud cover, the ground was mottled in large splotches of brown and white.

"As you can see, Meji appears substantially as described. Although it orbits its sun much closer than Earth or even Terranova, it would still be considered outside Cygni A's habitable zone since that star shines with only about a tenth of Sol's brightness. As with Terranova, however, a substantial amount of the satellite's heat comes from within, although caused by tidal friction rather than heat of initial formation."

"Could a large eruption have destroyed the colony?" Lars wondered.

"Possible," Terri said, "though the main settlement was intentionally situated away from the fault zones. Still, a body this active has hot spots that develop away from the plate edges."

"I don't think that's the situation." Tom was looking pleased with himself. "Obviously, we can't see the *Fortunate Wind,* at this range. However, I have been able to pick up some obviously artificial radio signals from two sources, one from the satellite, one from something orbiting it, presumably the arkship. So some people are alive on both."

Not necessarily, Lars thought, remembering old stories about houses and cities and ships continuing to function long after their human occupants were dead. There seemed little point in bringing up this possibility.

"If there are people both on the surface and in the *Fortunate Wind* able to communicate with each other, why have they ceased communicating with us?"

Tom looked uncomfortable. "I have no idea."

Lars looked from Terri to Amanda, awaiting suggestions. None were forthcoming.

"All right, then. We continue as before, trying to reestablish contact with the colony. Our goal now is the *Fortunate Wind.* If it is still functioning, we may be able to run a line from it to keep the containment bottles operational while we do the repair work."

Amanda's silence was eloquent. *Whether or not they want us to*, her look said. *Whether or not there is anyone alive to object.*

4.

"Isn't it a scandal when the captain is sleeping with the first officer?" Amanda asked. Her lips moved up his neck to do interesting things just beneath his ear.

"Not if they are married," Lars said judiciously.

"But isn't there still a conflict of interest?" Surprisingly strong hands worked on neck and shoulder muscles, massaging away deep knots of tension, loosening muscles he had not known existed.

"Rather an identity of interest, I should think." A groan escaped him as her fingers dug in, outlining each muscle and then forcing them all to relax. "Keep doing whatever it is you're doing. I had no idea I was so uptight."

"I don't know," Amanda said doubtfully. "You'll be no good to me at all, all limp."

"You needn't worry about that," Lars said, turning and pulling her close. An immeasurable amount of time went by without conversation. Later, barely floating above unconsciousness with Amanda snuggled close beside him, Lars allowed himself to consider just how remarkable it was that they were still together. The odds had been long against it. "I love and respect both of you," his brother-in-law, Jack Connelly, had told him, "but staying together through a fifty-year separation is the stuff of romances, not reality."

They had nearly come to the same conclusion themselves when the captains qualified list was released. Three names were gathered at the top: Hendricks, Connelly, and Lockerson.

"The good news," Amanda said, when she handed Lars the list, "is this proves I have been right when I've told everyone we are the best. The bad news is that now everyone else knows it."

"This could be something of a strain," Lars admitted, as he scanned the test results.

"Of course, I could decline the posting and request to serve as first officer on your shift." Amanda waited for a response. When none was forthcoming, she added: "Or you could do the same."

She was joking. She was deadly serious.

"Supposing that either one of us declines a captaincy, let us see what effect that would have on the rest of the list," Lars suggested. "To begin with, Lockerson becomes second shift captain."

"No problem there," Amanda said. "Jim's a solid guy."

Lars nodded. "Then Norma Austin becomes third shift captain."

There was an uncomfortable silence. "Vague on generalities, overly fussy on specifics," Amanda said. "Tends to get in a dither when the pressure is on."

"If you skip over her, you get Karl Martin. Knows every rule in every manual and can apply them. Has no idea how to handle any situation not explicitly detailed in the books."

Lars tossed the paper away. "Either one of them would make a good first officer. The question is: would you feel confident serving under either of them as captain?"

The other alternative was for both of them to stay on Terranova. Qualified astronauts could work in Skyguard, tracking interplanetary debris, occasionally nudging them into safer orbits, once in a great while pulverizing a particularly recalcitrant bit of rock. But if they both refused berths, there was a fair chance the arkship would never leave orbit. For the rest of their lives, every time they met Terri or one of her friends they would have to face the fact that they had caused the mission to be aborted. They would have to listen to the desperate messages from Meji knowing that no one was going to help.

And they would be faced with another choice. Conform to a society becoming increasingly impatient with dissent—or resist, with no idea what the eventual cost of resistance might be.

So despite all the doubts of friends and well-meaning advice, they accepted the offered berths of first and third shift captains. Although it was neither a comfortable nor an easy situation, neither was it impossible. Take the fifty-year extent of the journey. Each of them would be in the catacombs two-thirds of that time. The remaining sixteen years and eight months would be experienced as only half that time thanks to time dilation. The great explorers, whaling capains and their spouses, had traditionally been able to deal with separations of hat magnitude. They would be able to as well.

It helped that they were going to cheat. Overlap at shift changes was supposed to be five to seven days for the purpose of orientation. When the time came for Amanda to relieve Lars, they extended the overlap to a month. Shore leave, Lars called it.

He had been surprised to learn that they had become a legend. "Like Tristram and Isolde," Amanda assured him. "Like Étienne and Isabeau."

"More like Beatrice and Benedict," Lars said, laughing. "Why ever is anybody interested in us?"

Connected as they were to the various colonial societies only by (essentially one-way) radio broadcasts constituting the Interstellar Party Line, it was hard to say why any of the settlements other than Terranova and Meji should take any interest in them. And yet, if the messages they received were any indication, there was a great deal of interest. Some colonies, whose arkships were for various reasons no longer capable of interstellar flight, were undoubtedly fascinated and perhaps even envious of any still having the capacity. Others appeared to understand the importance of coming to the aid of an endangered settlement, even if that aid had to come from the other end of human inhabited space. Yet beyond that, there were apparently many whose hard, boring lives in only marginally livable environments seemed enlivened by the romance of a desperate, idealistic mission and the personal sacrifices required by that mission. At least two settlements had turned their voyage into ongoing soap operas. In one, Lars and Amanda were able to see each other for mere seconds between shifts.

Reality was hard enough without these romantic embellishments. Despite all the predictions, it was possible to keep a marriage functioning under those conditions. You just had to want to badly enough. Lars had surprised himself with the intensity of his determination.

Yet there was supposed to be a payoff for these sacrifices. Lars chided himself when he realized he was thinking this way. Like all of them, he had understood this mission to be a long shot. Now he realized that understanding was the product of the analytical part of his mind only. Deeper down, near his emotional center, he had been convinced that there would indeed be a fairy tale happy ending.

Now, as he lay next to Amanda, there was only a hollowness, a growing dread made all the worse because it could not be defined. He fell asleep, dreaming of an antimatter beast slowly devouring its cage.

5.

Meji rolled silently below them. Ice caps from both poles strained to engulf the satellite, failing only at a ragged fifteen-hundred-mile band around the equator. They were further foiled by hot-water plumes bubbling up from undersea vents, by chains of volcanoes and hot springs, all the result of the gravitational struggle between the A2 gas giant and the other satellites orbiting it. The brilliant ice fields were broken, sometimes by scimitar thrusts of blue-green open water, sometimes by brown and black volcanic bullseyes. Since they had attained orbit, Lars had counted more than a dozen active volcanoes staining the air above them with long spreading clouds of ash.

At the moment, his attention was focused ahead of them in orbit, on a brilliant speck which might be the *Schweitzer*'s twin.

"I have completed both laser and radar scans of the *Fortunate Wind*," Norma Austin reported. "Apart from some micrometeorite pitting of the hull, the ship appears to be undamaged. Analysis of the infrared signature indicates that the interior is being kept close to standard temperature. That means it must have power."

Lars nodded. "Mr. Lockerson, are we ready to go?"

"Boarding party assembled in the B and C airlocks." Jim Lockerson's voice was crisp in the headphones. "Crosswell's team just brought up the spool of superconductor. I'll go over with the first group at your command."

The first group would jet over to the *Fortunate Wind* and attempt entry at the locks closest to the engine room, cutting their way in with lasers if need be. Only when the ship was secured and the engines were on-line would the second group come across with the superconductor to be hardwired into the *Fortunate Wind*'s main electrical system.

"That should be in about fifteen minutes," Amanda said. She was sitting at the pilot's station, guiding the *Albert Schweitzer* to its orbital rendezvous.

There was a crackle of static. "Unidentified vessel. State your name and mission. Maintain your current distance. Approach no closer to the *Fortunate Wind.*"

Amanda raised an eyebrow. Lars nodded Restraining straps bit into his shoulders as she applied two brief spurts of deceleration.

"My name is Captain Lars Hendricks and this is the *Albert Schweitzer* out of Terranova in the Epsilon Eridani system. Our mission is to provide medical relief to your colony. You should know these things since we have been in regular contact with your colony for the last fifty standard years.

"May I please see whom I am addressing? We are receiving only the auditory part of your signal."

The pause was so long that Lars feared they had somehow lost contact. Abruptly, his screen came to life. A familiar face stared out of an almost leonine mane of black hair. Lars searched his memory for a name.

"I am delighted to see you, Toshiro. After you ceased transmissions six months ago, we feared the worst."

From beyond the range of the camera focused on Lars, Terri held up a doubtful hand, shaking her head.

"Toshiro Hama has been removed from this position. I am Koson Hama."

Which, of course, was why Terri had been shaking her head. "My apologies Koson Hama. Why do you warn us off?"

"Reasons of medical safety. We judge

the danger of infection to be severe."

Lars felt himself relax. "Hama-*san*, I appreciate your concern for our well-being, but I can assure you that it is misplaced. We have developed a vaccine against the flu that has so ravaged your colony, and every member of the crew has taken it. Even if it has somehow mutated so as to become immune to the vaccine, the medical facilities on board are sufficient to develop a new vaccine and care for anyone who might become sick in the interim."

"With all respect, Captain Hendricks, the safety of your crew is not our main concern." Koson's voice was crisp and cool. "Even though we have become almost completely immune to the flu while your vessel was in transit, I am sure you have at least some conception of losses our colony suffered before the advent of that immunity. We could not repeat that experience and survive. It is more than a century since our ancestors left Earth. The Sensei believe that during that time, your population has encountered and gained a resistance to many viral and bacterial strains with which we have no experience. Were we to meet now, it is all too likely that we would be infected by what to your are innocuous strains, and that they would finish the job begun by the flu. We cannot allow that to happen."

Lars looked over at Terri. *Is this a possibility?* Reading his lips rather than hearing him, she nodded.

"Hama-*san,*" Juanita Alvarez said, "I am the ship's doctor. We understand the nature of your concern. However, we are easily able to provide sterile facilities. With only a few blood samples from your people, we would be able to fashion immunization boosters that would eliminate all danger of serious infection."

Koson Hama appeared to consider this. For a few seconds, they lost the sound signal. Koson appeared to be listening to someone off camera.

"I have no doubt of your sincerity," he said at length. "Nonetheless, I am sorry. The danger is too great."

"This is a surprising greeting," Lars said, "for those who have taken so long to come so far in order to aid you."

Koson grimaced. "This is indeed most regrettable. I can only repeat that the disease which was the original motivation for your voyage is now under control and that we dare not risk the onset of new diseases. It is that simple."

"Pilot," Lars said. "Resume previous intercept." Amanda looked surprised, but entered the commands to comply.

"It is not quite that simple," Lars continued, licking dry lips. "We need your help to deal with an onboard emergency." He braced himself against a short burst of acceleration. "The engine room mixing bottle for matter and antimatter is undergoing progressive deterioration. We can send you a detailed analysis of the problem as well as our computer extrapolations. For our purposes right now, you need know only that when the mixing bottle fails, we shall have no way to generate energy. When our backup batteries fail, the bottle containing the antimatter will itself vanish. This will cause an explosion in excess of one thousand megatons. You can prevent this by providing us power to maintain the bottles while we effect the necessary repairs to the magnetic coils.

"Because we came to your aid, we now need your help more than you ever needed ours. We have only two standard weeks."

"That is regrettable, but there is nothing we—what are you doing? Why is your craft approaching? I warn you again. Maintain your distance."

Lars regarded him with wide eyes. "I am sure that when the Sensei understand our plight, they will be eager to aid us."

A series of emotions flashed across Koson's face too quickly to be deciphered. Then the screen went blank.

Amanda brought the *Albert Schweit-*

zer within fifty meters of the other starship. Terri was troubled. "Is it wise to provoke them? We have no weapons should they attempt an attack."

"That is not quite true. Pilot, change our orientation, gently if you will, so that the exhaust nozzle points directly at their bridge." His chair pressed gently against his back as the ship came about.

"Captain." Sydney Crosswell's voice came across the intercom from Engineering. "You do realize that if I have to provide thrust from the main engines, the exhaust will go through that ship like a laser through frost."

"I am well aware of that, Mr. Crosswell. I trust it will give our reluctant hosts much to consider."

6.

"It is absolutely shameful," Terri Lee said, glaring across the table. "Depending on how one counts the Oort and planetesimal settlements, there are between twenty and fifty human colonies. It is impossible to get up-to-date data, but the best estimate places the current population of all of them at no more than ten million. That figure gives an exaggerated sense of the race's well-being, since all of these colonies are located in areas of greater or lesser hostility to Terrestrial life Some are small, hanging on to existence precariously.

"For the sake of our race, every one of them must be given every aid to its survival. That is why, fifty years ago, I began my campaign against the Terranova Colonial Council, the campaign which resulted in this ship being put at my disposal. The only reason you were in the competition to command this vessel is because I thought you shared my vision. Yet now you are willing to go to kill the very people we came to save."

She stared at Lars as if daring him to defend himself. Amanda bit her lip and shook her head slightly, as if fearing an intemperate response. Sydney Crosswell and Jim Lockerson both looked uncomfortable.

Lars rubbed his forehead wearily. "As it happens, I agree with almost everything you have said. It seems sinful in the extreme to come all this way to start a war. At the same time, it makes our lives seem something of a sick joke to sacrifice so much for this mission only to learn at its climax that we are not wanted." He tried to look anywhere other than at Amanda as he said this.

"That being said, however, I do not have the option of just turning around and going home, even if I wanted to do so. As Overcaptain, I am responsible for the lives of everyone on board this ship. My apologies if it seems unenlightened or barbaric, but if it comes to us or them, I'm going to come down on the side of us every time. I told Koson the exact truth when I said that without their help, this ship will become a miniature nova."

"But you did not tell them the exact truth about the timing," Sydney interjected. "You said two standard weeks. The figures I worked up give us no more than ten days."

"Quite so. If I gave them the correct figures, they might well nerve themselves up to a pre-emptive strike before the ten days are up, to give them time to take control of this ship and either move it to a safe distance, or disable it and move their arkship away. If they actually want to help us, it should take them no longer than two days to decide."

"Counting from your last communication, that is only thirty hours from now," Jim said. "And if they do not decide to be good neighbors?"

"We reassemble the crew you were going across with, only we double the number since it will be an assault force as well as an engineering team. We will do everything we can to limit the violence." This with a significant look at Terri. "Damaging any part of the engines would defeat the whole purpose of what we are doing."

Sydney rubbed his chin doubtfully. "I said earlier that my repairs would take at least thirty hours. That was to get them back to initial operating condition. To ruggedize them, to put in the extra safeguards to prevent a recurrence of this situation, will take closer to sixty hours. Can Jim's group give my crew that much time, if the crew of the *Fortunate Wind* makes a series of determined attacks?"

"They will have to," Lars said, "since I see no alternative that keeps us from becoming photons."

Jim winced. "Thanks for the vote of confidence."

"Sydney retrieved the blueprints for their arkship from the onboard library," Lars said. Color-coded schematics appeared over the table, rotating slowly. "As you can see, our ships are in most respects identical. If we can hold these three passageways—" The program outlined them in crimson. "—we should be able to prevent any interference."

"Suppose they come around the outside," Jim suggested. "I see exterior locks *here* and *here*."

"Good thought," Lars agreed. "I think you can—"

Three quick chimes sounded over the intercom. "Captain Hendricks, this is Communications. Beg pardon, sir, but we have just received a message from Koson Hama. It appears that the Sensei have yielded to our demands. They wish to send a party aboard to work out the details of the electrical hook-up."

"I thought you would be happy with this result," Amanda murmured, one step behind him. "Or isn't capitulation good enough anymore?"

They stood opposite the main engine room air lock, as much as anyone can be said to stand in free fall with their half-boots attached to the Velcro carpeting. Sydney was a few paces to one side, with two assistants. Inconspicuously attached to their tool belts were small welding lasers that had been modified to serve as hand weapons. Terri stood on the other side, looking strained.

"Capitulation is fine," Lars replied. "I just wish I could be sure that's what this is. I really did not think they would come to terms this quickly. This group could be a reconnaissance team, or the first assault wave."

There was a slight static hiss in his ear. "I count five individuals leaving their nearest airlock," Jim reported from the bridge. "They are guiding themselves over with short bursts from their suit maneuvering units. Estimate arrival in less than sixty seconds."

"Are they carrying anything with them?"

"Two of them are trailing small packs. No obvious heavy artillery."

Lars grunted. "And our security team?"

"Four of them are pre-positioned in the engine room. The others are in the corridors behind you. Per your orders they will keep out of sight, but they will also maintain the same distance from your party as you move. I will be following everything on the monitors."

"Sounds good," Lars said.

The seconds fled by. The status screen by the airlock cycled from green to red to green again. The inner door slid aside. Five spacesuited figures pulled their way in cautiously and surveyed the welcoming party. They made no move to remove their helmets.

It seemed awkward under the circumstances to offer a handshake. Lars decided that a slight bow would be appropriate. "Welcome to the *Albert Schweitzer*, Koson Hama. I thank you for coming to our aid."

The familiar face frowned without comprehension. A string of slightly nasal syllables erupted from within the helmet. Lars thought he caught a familiar name or two. Although he had devoted part of his spare time to learning Japanese each shift, his conversational fluency was pretty much limited to *konnichi wa* and *hai*.

Terri moved to his side. "He says that his name is Takakura Hama. He seems to be fairly important. I caught something that sounded like he was the only son of the leader of the Sensei. He wishes to inspect our engine room."

Lars winced at being caught in the same mistake twice in a row. "Ask him to follow me." Detaching his boots from the Velcro, he grabbed onto a handhold on the wall and began brachiating down the corridor, taking care to go slowly enough that nobody was left behind.

Although the largest compartment in the ship, the engine room was nonetheless cramped. Masses of multicolored piping snaked their way through the air at such odd angles and in such profusion that one did not at once see through them to the huge chamber which contained the antimatter. Immediately at hand, bank of dials and readouts detailed the amount of energy being produced, the strength of the magnetic fields, and how much energy was being consumed by various shipboard functions.

Takakura Hama spoke again. "He would like to address your Chief Engineer," Terri explained.

"Mr. Crosswell. Front and center."

With Terri's aid, Sydney was introduced. "He says he has a counterproposal, an alternative. There seem to be potential problems, which he doesn't specify, with using a cable. His idea is to use microwaves."

Sydney cocked his head to one side, thinking, then looked over at Lars. "Might work. The shops would have to throw together a receiver, but that shouldn't be a problem. I need the details."

While Terri translated, one of Takakura's assistants studied the dials, comparing them to files on his electronic notebook. Abruptly satisfied, he jumped off the deck, grabbed one of the overhead pipes, and opened the access panel. Steel flashed in his hand.

What happened next occurred so quickly that, even after reviewing the recordings many times, Lars was not sure he had seen everything. He was sure only that he did not fully understand what he was seeing.

Wycliffe, a junior engineer looked up in alarm. "Excuse me, sir!" The assistant gave no indication of hearing him. Wycliffe sailed up behind him and put a restraining hand on his arm. It was shaken off impatiently. Even more concerned now, Wycliffe braced himself against the wall, grabbed the offending arm, and levered backwards. As if taken totally by surprise, the assistant let go and did a free-fall somersault which terminated only when his helmet connected with a higher rack of pipes.

Although close together, two sounds were quite distinct: the helmet hitting the pipes, and the head impacting on the interior of the helmet.

Everything stopped. Takakura Hama cut off a question in midsyllable. His three other assistants froze motionless, looking upward. Above them, a red smear appeared inside the helmet of their comrade. There was a high, thin scream, muffled by the enclosing plastic.

There were no words. Two of the assistants jumped up, grabbed their companion, and kicked off the wall toward the open door. Takakura was already ahead of them. The fourth assistant brought up the rear, looking nervously left and right as if expecting an attack.

Lars did not remember any orders, but the voices on the recording were quite clear.

CONNELLY: "They're heading for the airlock. I have people in range. Should I—"

HENDRICKS: "No! Let them go."

It was over in less than a minute. "Can someone tell me what the hell just happened?" Lars asked plaintively.

"Mr. Wycliffe acted correctly." Sydney's face was red and there was an edge to his voice. He looked around the table as if daring any of them to refute him. "He perceived a threat to one of the main power cables. He yelled a warning. When that was ignored, he gently sought to restrain Takakura's assistant. Only when his hand was forcefully thrown off did he pull the man away, and then with the minimum force necessary."

"Which minimum force left his victim bleeding profusely," Terri observed

"From a nosebleed, for pity's sake!" Sydney protested.

"And was the power cable actually in danger?" Amanda asked, her voice carefully neutral.

"Well, apparently not," Sydney admitted. "Review of the recordings indicates that the flash of metal was from an input jack, not a knife. The assistant was apparently trying to confirm the carrying capacity with his own software. That would have allowed his group to refine the estimates of how much power they would have to provide."

"So at that point, they were acting in good faith to aid us," Lars said. "Afterwards, they fled the ship and have not responded to any attempts at communication since. It would seem that Mr. Wycliffe's actions made the difference."

"It wasn't his fault," Sydney insisted.

"Right now I am less interested in assessing fault than in trying to assess what happened and why Takakura's group reacted the way they did." Lars grimaced. "If we cannot find a way to undo the damage, the only option left is to take their ship by force."

"I think their reasons are pretty obvious," Sydney said. "We injured their precious pride so they stalked off in a snit."

"I don't see outrage in their faces," Amanda said. "I see fear."

For the umpteenth time, Lars replayed the scene on his desk console, splitting the screen so that he could observe both the Takakura and the group with him as well as the one with Wycliffe. He found himself nodding. Body language expressed shock. What little he could see of facial expressions, of eyes incredibly round and white, indicated nothing short of panic.

Yet he understood Sydney's mistake. Takakura and his companions had carried themselves proudly, almost arrogantly, from the moment they entered the ship. All nearly identically handsome. What was it about a shove and a nosebleed that could induce stark fear in such men?

Lars replayed their initial entry. They moved with the grace and confidence which brought to mind recordings of jungle cats on old Earth. Lions, jaguars, cheetahs. There was something about cheetahs, something important if he could remember it.

"Terri, when Takakura came on board, I thought he was Koson Hama. Earlier, I mistook Koson for Toshiro. I put down the errors to cultural parochialism. Were the differences obvious to you?"

Terri shook her head. "Your mistakes were excusable. They look very much alike. Given the surnames, it is almost certain they are all related."

"So it isn't just my own provincialism," Lars said. "Tell, me, how large was the Meji colony before the plague?"

Terri looked puzzled at the apparent change of subject. "Arkships had a standard complement of 3,000. There had been time for some births, but there had probably been some catacomb deaths as well. We were never given that data, so I am assuming they pretty much washed out."

"How many were killed in the first epidemic."

"No data," Terri said. "They have always been reticent with that sort of information."

"But you can extrapolate," Lars insisted. "Based on Terranova's experience before the vaccine was developed, what would the mortality rate of the disease be unchecked?"

"As much as 90 percent," Terri said soberly.

"Leaving only 300," Lars said. "One hundred fifty breeding couples. Maybe."

"That's actually below the minimum

number said necessary to run a colony," Amanda noted. "No wonder they wanted everything we had on robotics. There weren't nearly enough people to do the basic chores of growing food, building an atmosphere, and refining materials."

Lars nodded. "It gets worse. Five years later, the second epidemic strikes. I don't think we were ever given the mortality statistics on that either, but what would you estimate?"

"Most of the survivors of the first epidemic would have acquired a long-term immunity," Terri said. "Much would depend on their general state of health, but I would think that no more than a third would be lost the second time around."

"So before their first call for help gets to us they are down to a hundred couples," Lars said. "Twenty years, a generation, has already passed. You realized pretty quickly that Meji had lost so many of its medical personnel that no amount of radioed data would suffice. How long, though, was it between that realization and the *Albert Schweitzer*'s launch?"

"Seven long, increasingly bitter, years."

"Right. And then, in their frame of reference, it took us forty standard years to get here. More than three generations altogether, waiting for help to come."

"If the colony is a small as you suggest, it is surprising that they split their personnel between the *Fortunate Wind* and the ground installation," Sydney said. "It just compounds the understaffing problem."

"For some of them, it may be necessary to live shipboard," Lars suggested.

Terri's eyes widened as she understood his implication. "No! It's too quick for that type of damage . . ." Her voice trailed off as she reconsidered her words.

"Perhaps," Lars allowed. "You and Dr. Alvarez are our experts. But if I am correct, then we have something the Mejans need as much as we need their electrical power. Now the problem is to convince them of that."

Involuntarily, he glanced down at his chronometer, which was steadily ticking off the days. "We have very little time left."

7.

Lars sat in the captain's chair on the bridge, feeling the weight of the cameras focused on him. In the next few minutes, he would have to convince a hostile audience that might choose not to listen to him. He would have to seize their attention with little more than educated guesses, telling them things about themselves they might well find offensive. Most difficult of all, he would have to convince them to agree quickly.

Even if worst came to worst, they had decided not to fire on the *Fortunate Wind.* Instead, they would eject the antimatter bottle so that it would explode below them in the upper atmosphere. This would disrupt communications with the ground base. With luck, it might distract those shipboard sufficiently to allow the boarding party precious extra seconds before they were detected.

The communications officer signaled him. "Five seconds to transmission . . . three, two, one."

Lars cleared his throat. "People of the Meji colony, I wish to apologize for an unfortunate incident which occurred less than twenty-four hours ago while the crew of your arkship was inspecting our engine room. A member of our crew, misunderstanding the intention of one of your people, endeavored to protect our ship in such a way that your fellow colonist was injured. I assure you that he will receive appropriate discipline."

Even with a weasel word like "appropriate" Sydney would fume at that. Well, let him.

"We must not let this incident end our cooperation. Some of you believe we can be only a source of infection, that we have nothing of value to offer. It is true that the original purpose of our voyage has been overcome by events. You have developed a natural immunity to the plague which brought death and suffering to both our colonies. That immunity arose only after you lost the greater portion of your population, including all your biologists and all your doctors. You have tried to make do with robotic factories and you have succeeded—in the short run. Yet there is a danger to your colony greater than any plague, one beyond the power of automation to remedy. Only we can provide what you need."

Deep breath. After all, things can't possibly be worse than they are already, right?

"You need our germ plasm. The current size of your colony is too small for an adequate breeding population. Already you have had to station hemophiliacs in the *Fortunate Wind* in the hope that they will be less likely to harm themselves in free-fall. This is only the beginning. As you become increasingly inbred with each generation, the genetic effects will become more serious.

"If you do not help us, we will be destroyed in an instant of flame. You will continue for several more generations, descending ever further into illness, feeble-mindedness, and insanity. We will be the lucky ones."

He stopped, having run out of words. After a moment, he signaled the communications officer to cut the transmission. Then he left the bridge for the conference room, to plan the last details of the assault with Jim and Amanda.

The call came in five hours before they were to eject the magnetic bottle containing the antimatter. A new face, marred by bruises and a cut lip, peered uncertainly out of the screen.

"Captain Hendlicks? I am Shintaro Sato. Apologies for silence. There has been a change of regime and much confusion. We wish to help. How soon do you need power from us?"

"Immediately," Lars said.

8.

He stayed on the bridge even after power started flowing to the *Albert Schweitzer* and Sydney's crew began their repair of the reaction chambers. He had already been awake twelve hours when the call came in. Twenty hours later he was jittery with sleep suppressors and beginning to hallucinate. It occurred to him that he had said the most offensive things imaginable to a very proud people, that they might choose to avenge the dishonor by interrupting the flow of power for just a second. The resulting explosion would destroy their starship, but that might be considered an acceptable price.

At some point, Lars became aware that Amanda was speaking. He could not remember how long she had been seated across the table from him

"Go to your quarters and go to sleep." There were little pauses between each word, as if she were talking to a child. "You are no good to anyone this way."

He nodded gravely. "I am aware of that." He was overenunciating his own words, the verbal equivalent of a drunk ponderously trying to walk a straight line. "The problem is that even without the suppressors, I would not be able to sleep. Sign of weakness, I'm afraid."

Amanda nodded with a sad smile and left him. Some time later there was a ragged cheer that seemed to come from far down the corridors. Then Sydney bounded quite literally onto the bridge and grabbed Lars in a bear hug and began pounding him on the back as they tumbled in mid-air in a quite undignified manner. The bridge was suddenly full of people hugging and crying and laughing. By this means, Lars understood that Sydney had been successful, that the *Albert Schweitzer* was under its own power once more and in no further danger of blowing up.

He managed to make the announcement via the speaker system to the crew, most of whom had already heard or guessed. He then contacted Shintaro Sato to express his thanks for their help. His last command was for Amanda to move them a safe distance from the Mejan starship.

He must have inhaled the counteragent to the sleep suppressors, but he did not remember it when he awoke in his bed fourteen hours later.

9.

The banquet room was ornate and overcrowded. Unfortunately, the air conditioning system was not up to dealing with the body heat produced by the combined hierarchies of the *Albert Schweitzer* and the Mejan colony. Sweat glistened on foreheads, stung eyes, soaked armpits and crotches. Everyone politely pretended that his neighbors did not smell.

The speeches, at least, were not as long as they might have been. Goto Hama, Elder of the Sensei, thanked the crew for their years of sacrifice, for the medical advances which were even now healing the sick of the colony and would guarantee the health and well-being of generations. This was, he said, a debt which could never be repaid. He concluded by inviting all members of the *Schweitzer*'s crew to settle, to join in making ever stronger and more prosperous in the coming years.

He said all these thing in a monotone, looking neither to the left nor the right, moving his lips as little possible, as if speaking through clenched teeth.

Lars, speaking for the crew, thanked the colonists for their magnificent generosity, spoke briefly on the pleasures of completing a long-term task of great importance, alluded even more briefly to the evolutionary advantages of altruism, and concluded with variations on Virtue is its Own Reward. He then seated himself to enjoy the banquet, manipulating unfamiliar implements to bring to his mouth food with sometimes disturbing textures and tastes.

It was several hours later when he stepped from the guest quarters which had been provided onto the balcony that encircled the entire building. He walked carefully in the unaccustomed gravity field. Blood seemed to pool in his lower extremities. Light-headed, he grasped the railing tightly. Behind him, he could hear the hum of continued conversation, even though it had become obvious an hour ago they had reached stalemate.

He had come out to clear his head. A cold wind swept in from the darkness. There were supposed to be farms out there, and mines a little further toward the mountains. There were even one or two active volcanoes in that direction. None of this was visible. Except for the light leaking through the shutters, he could have been alone on a deserted world.

The stars were unfamiliar. Not because of the distance. Twenty light-years is nothing in galactic terms. It had been decades since he had looked at any but guide stars to get navigational bearings.

There was a slight sound. Looking down from the stars, Lars saw that two figures had approached. In the dark, he could see nothing of their features. They stopped and made short, nervous little bows.

"Forgive us for intruding," the closer one said. "I am Shintaro Sato. This is my friend, Toshiro Hama. We would speak with you, if we may."

"Certainly," Lars said, recognizing their names. They had not been at the banquet. None of those with whom the *Schweitzer* had maintained contact had been present. Only now did he wonder why.

"We were wondering how you . . . how you knew," Toshiro said.

Lars heard the hesitation, and realized the embarrassment which lay behind it. "I saw the Hamas, all proud and regal and all very much alike, and found myself thinking of cheetahs. Do you know what cheetahs were?"

Toshiro shook his head. "A wild animal," Shintaro said. "Some sort of large cat?"

Lars nodded. "We had a small zoo back on Terranova. The ostensible purpose was to provide a staging area for bringing back livestock as we pressurized sufficient acreage to support it. However, the old guy who ran it, Director Weiner, had this vision of eventually recreating an old Earth ecology. Every so often he would go to the gene banks and resurrect some wonderfully exotic and useless animal to see if he could infect others with his enthusiasm.

"Lions had been a big hit, so he tried cheetahs next. They had all sorts of difficulties: hip displacement, susceptibility to disease, heart problems. At first, Weiner thought that he must have made some mistakes in the birthing process. When he researched it, though, he discovered that the problem was with the genetic stock. About the end of the last ice age, cheetahs went through a severe population bottleneck. So few survived that, by the time Earth was evacuated, the surviving descendants were almost as closely related as identical twins.

"That was my impression of you. And when we ran the numbers on your population estimates, I realized that the impression might be valid."

"The Hamas were inbred even before the Diaspora," Toshiro muttered. "When we came here, the practice was continued to maintain 'purity,' to strengthen the alliances which were the keys to power."

Shintaro looked away, embarrassed for his friend. "You can't stay here, you know."

The surprising thing, Lars thought, was that he did not feel at all surprised. "Why not? The Eldest of the Sensei just nvited us to stay. He all but pointed out parcels of land that are ours for the asking. He said that he owed 'a debt which could never be repaid.'"

"Debts which can never be repaid eventually become a source of . . . irritation," Toshiro said. "My grandfather meant every word he said. But he is shamed that we came so close to letting you die and dooming ourselves at the same time. He fears you and the contamination you represent—not viral, but cultural. It is irrational, and he knows it is irrational, but he feels it nonetheless. He is far from the only one.

"If you elect to stay, he will provide the land promised. You will settle on it, and build a town. It will reflect your culture, which is not our culture. When the new children our born, the ones with some of your genes, we will look at them and at your town and wonder where they truly belong."

"Not a good situation," Lars allowed. "What the alternative? We just say 'So long, ma'am, but I gotta be heading west?'"

Both of them frowned in puzzlement. "The alternative," Shintaro said, "is that you leave and take us with you."

That *was* a surprise. "Indeed? Come inside with me. I have some people who will want to hear what you have to say."

He shut his eyes against the glare as he pulled open the doors leading to the common room. As he adjusted to the firelight streaming from the great hearth, he made out, seated in various poses, deep in discussion with their neighbors or sitting alone in frustrated silence, the main officer cadre of the *Albert Schweitzer:* Amanda Connelly, Sydney Crosswell, Jim Lockerson, Terri Lee, Juanita Alvarez. Lars made the introductions.

"Our friends tell us we can't stay here," Lars said. "They also say that when we leave, they want to come with us."

There was a shifting of positions, a muttering half of protest, half of self-satisfied validation. Terri Lee sat bolt upright, looking stricken. "I have been offered the position of Chief Medical Officer. I am to have charge of their hospital and their medical school."

"After what you have done for us, we would have to give you whatever you asked," Shintaro said.

"And you look like us," Toshiro added pointedly.

"Why do you want to become part of our company?" Amanda asked.

"This planet stifles me," Shintaro said. "Stifles us," he corrected after a look from Toshiro. "The Sensei want to recreate a past that never really existed. That dream is impossible. You have proved it, though some deny it yet. And we—we would be unhappy if it could have succeeded."

He said this last quickly, as if confessing a particularly shameful sin. "Dr. Lee, you thought you were giving us practical information to help our colony survive. You gave us much more than that. You gave us a window on the stars."

"You told us that things could be different," Toshiro added, "that in other places they *were* different. When I listened to your transmissions, it was like the only time I could really breathe."

"Unfortunately, we are outlaws of the stars," Lars said. "Terranova pretty much forced us into exile. The current government considers us thieves."

Toshiro and Shintaro both looked stunned by this announcement. "How can this be?" Shintaro protested. "How can they say this about such a band of heroes?"

"At least as easily as the people saved by the heroes can tell them they're not wanted," Lars replied. Toshiro winced. "And I must admit," Lars continued, "that I am getting tired of a life of heroic self-sacrifice. I would give a great deal right now for something approaching a normal life."

Jim Lockerson looked from Lars to Amanda and back again. "We could go from three shifts to two. Or if we stay on three, we may be able to shift personnel. It seems to me that Norma Austin and Karl Martin have seasoned enough to be due a promotion."

"But where do we go?" Lars asked.

"Anywhere there is a human colony," Juanita Alvarez said.

Lars looked at the ship's doctor curiously. "I mean it," she insisted. "Every colony in existence will need us as much as Meji has."

"As far as I am aware," Terri said carefully, "all other colonies have sufficient breeding populations."

"They have island breeding populations," Juanita said. "Over the course of generations, random mutations will cause genetic drift. New racial varieties will arise. Given enough time, they will become separate races in the strict meaning of the term, unable to interbreed."

"Is that necessarily bad?" Amanda asked. "If they adapt to their environments—"

Terri gave an unladylike snort. "Listen to what Dr. Alvarez said. There was nothing about adaptation. She was describing random genetic drift. This is one of the few colonies where humans have a natural environment to which they can adapt. Nearly everywhere else, Terranova included, we are living in artificial environments of our own creation."

"The hostility we faced will be nothing to the racial animosities that will fester then," Juanita said. "We will have a situation which has not been seen since the extinction of the Neanderthals. Except, I think it will be worse than that. From our point of view, there will be no human race left. There will just be dozens of variant races, isolated, suspicious, and alone.

"We can prevent that. We can ensure that there will be sufficient mixing to keep all colonies members of one human race. We can make certain tha there is always a store of undifferentiated mongrel human genetic materia ready to provide a diversity, perhaps even a hybrid vigor, to racial strains which might otherwise brittle with specialization."

In the dramatizations of years to

come, Overcaptain Lars Hendricks would respond with whole-hearted enthusiasm, describing not just the course the rest of their lives would take, but also the next three hundred years evolution of human-occupied space. At least two operas would climax with choruses joining in to celebrate the argosies of exploration and commerce that would unite the far-flung human race.

At the time though, he felt tired, uncertain, and a little bitter. You should remember this when you read or hear his words.

He lifted his glass in a toast. "To ourselves, then. Exiles. Outlaws of the stars.

"The saviors of the human race."

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THE REFERENCE LIBRARY Tom Easton

Blind Waves, Steven Gould, TOR, $23.95, 351 pp. (ISBN: 0-312-86445-0).

OceanSpace, Allen Steele, Ace,, $21.95, 375 pp. (ISBN: 0-441-00685-X).

Midnight Robber, Nalo Hopkinson, Warner, $13.95, 330 pp. (ISBN: 0-446-67560-1).

Silverhair, Stephen Baxter, Harper, $24, 213 pp. (ISBN: 0-06-105132-2).

Magnificat, Chelsea Quinn Yarbro, Hidden Knowledge (1181 Martin Avenue, San Jose, CA 95126, *http://www.hidden-knowledge.com/magnificat/*), $11.95 download, $13.95 floppy, $16.95 CD-ROM (ISBN: 0-9679159-0-2).

The Wonderful Edison Time Machine, Malcolm Willits, Hypostyle Hall (6225 Hollywood Blvd., Hollywood, CA 90028-5310; 323-467-9459), $65, 224 pp. (ISBN: 0-9675253-0-6).

Strange Travelers, Gene Wolfe, TOR, $25.95, 383 pp. (ISBN: 0-312-87227-5).

E-Topia, William J. Mitchell, MIT Press, $22.50, 184 pp. (ISBN: 0-262-13355-5).

Digital Mythologies: The Hidden Complexities of the Internet, Thomas Valovic, Rutgers University Press, $26, 221 + xvi pp. (ISBN: 0-8135-27554-6).

When I was young, more than halfway back to Hugo Gernsback's midwifery of the SF genre, it was not at all uncommon for me to pick up an SF novel and be unable to set it down until I had turned the last page.

As the years have passed, that experience has grown less common, and even rare. I can think of three reasons why: SF ain't what it used to be, I ain't what I used to be, and I have read so much over the years (I've covered almost 1,700 novels in this column!) that it's now harder for a story to thrill me.

But it can still happen, and here's the one to prove it: Steven Gould's **Blind Waves**. The setting is an Earth devastated by global warming. Sea level has risen a hundred feet and turned most of humanity—who live within that distance of sea level—into refugees. The largest branch of the U.S. military is now the Immigration and Naturalization Service (INS), whose job it is to intercept and impound in camps such as those of New Galveston the hordes of illegal immigrants.

Meet Patricia Beenan, who lives on New Galveston, has a seat on the council, and operates an underwater salvage business from a trimaran whose center hull is a detachable submarine. She's looking for the source of an oil plume so an oil company tanker can recover the oil. What she finds is a sunken freighter whose hull bears wounds that look just like those inflicted by INS cannons. In its hold are fifty bodies. And an INS gunboat is hovering on the horizon.

Patricia's got guts. She videotapes the carnage and uploads it to the Net, complete with the GPS coordinates. Then she runs like hell to get away from the pursuing INS. Luck, ingenuity, and more guts help her out, and a few days later she is being interviewed by Thomas Becket, a scar-faced investigator from the INS's own Criminal Investigation Division. They fall for each other very rapidly, and soon they are both on the run, dodging bullets and bombs while they struggle to put paid to a gang of greedy racist thugs before they can commit an atrocity much, much worse than the one that started the tale.

This one has it all: Reasonable extrapolation, love and passion, chase scenes and evil schemes, suspense and sudden death, and a burst of shiny, romantic optimism at the end.

Don't miss it.

Allen Steele's **OceanSpace** is a fine yarn, but it's not as gripping as Gould's. The setting is the Atlantic Ocean off the southeastern U.S. coast, where Tethys I (floating at the surface) and Tethys II (deep below) seek to tap the resources of the deep. Robots scoop up manganese nodules to be ferried to the base by deep-diving subs such as the *Doris,* piloted by Joe Niedzwiecki. All is routine, until Joe encounters a monster of the depths, perhaps a sea serpent, that forces him to launch his escape capsule to the surface. Meanwhile Peter Lipscomb is foiling a pirate whaler with a shot of computer viruses, while his wife Judith, vacationing on Dominica with her long-time mentor Charles Toussaint, is fighting off would-be kidnappers, even as their niece Andy is arriving on a combination visit and escape from feudng parents. And let us not forget the nosy reporter with an eye for married guys.

There is loads of potential excitement here—an industrial spy has to be nailed, a murderer caught, a teen grown up a bit, a conniving female foiled, a seabed eruption studied, a sea serpent sought—nd Steele has assembled it all into a satsfying tale that might do very nicely in Hollywood.

But to my mind, Steele failed to take ull advantage of his material. It's not hat he swamped the plot in a wealth of echnical detail about Tethys's operaions and structure, for though there is plenty of such detail, he doesn't really eem to have overdone it. The problem may be that he tossed in too many elements; if he had just left out the sea serpent, the other elements would have stood forth a bit more vividly and the whole would be a bit more pleasing.

At least, to me.

Nalo Hopkinson established herself as a lady to watch with her first novel, *Brown Girl in the Ring* (reviewed here in December 1998). With her second, **Midnight Robber**, she does nothing at all to spoil that first impression. Look for it on the SF&F award ballots, and don't be too surprised if Hopkinson eventually wins big outside the genre.

Robber is set in a distant future whose people seem mainly from what we know today as Third-World countries. This might strike you as a bit PC, but if you think a bit, you must realize that indeed history has a way of turning global hierarchies on their heads (when the first millennium rolled around, Europe was a backwater; the one before that, the Romans were playing Legionnaire-and-Frank in the woods there).

Hopkinson's own affinities are the Caribbean. Thus we have the planet Toussaint, preparing to celebrate Carnival in traditional fashion. The patois sings of the West Indies, and though it takes a bit of getting used to, Hopkinson handles it with an evocative and masterly hand. Listen to how the story-she begin: "It had a woman, you see, a strong, hard-back woman with skin like cocoa-tea. She two foot-them tough from hiking through the diable bush, the devil bush on the prison planet of New Half-Way Tree. When she walk, she foot strike the hard earth *bup!* like breadfruit dropping to the ground. She two arms hard with muscle . . . Even she hair itself rough and wiry; long black knotty locks springing from she scalp and corkscrewing all the way down she back. She name Tan-Tan, and New Half-Way Tree was she planet.

"Yes, she was a hard woman, oui. The only thing soft about Tan-Tan is she big, molasses-brown eyes. . . . ."

At the start, Tan-Tan is just a child, looking forward to Carnival and her

Robber Queen costume (the Midnight Robber is the Trinidadian Robin Hood). But Mommy's playing around, and Daddy Antonio, local mayor, is a jealous man who schemes a duel with his rival. He fights foul and flees to the gate that punts felons across a dimensional gulf to the prison world of New Half-Way Tree, taking Tan-Tan with him. Once there, they are assisted by a local native, find a village of exiles, and settle in. And soon Antonio is molesting his child.

Tan-Tan reacts normally with guilt and self-loathing. But as her sixteenth birthday approaches, she plots flight with her friend Melonhead and her stepmother gives her a knife. When Daddy Dear goes for her again, Tan-Tan defends herself. Soon the dogs are on her trail, the natives are assisting once more, and she is learning much more about New Half-Way Tree than she—indeed, than any human—had ever suspected. Before long, she is playing Robber Queen for real, pursuing redemption by helping the downtrodden from her forest refuge.

And when the jig is up at last. . . . Suffice it to say that all ends well for Tan-Tan and there are signs of promise for the future.

Don't miss.

There was a time when mammoths—big, shaggy, curve-tusked relatives of the elephants—roamed the tundra between the Ice-Age glaciers and the forest. A dwarf variety may have survived on Wrangel Island off the coast of Siberia until as late as 3700 B.P. Mammoth remains are found in North America, Europe, and Asia, and one Siberian frozen carcass has been in the news lately because of the plan to extract enough DNA (or perhaps frozen but viable sperm) to create a mammoth-elephant hybrid for the zoo.

That's the human tendency, isn't it? Find something marvelous, and use it. Kill it, skin it, eat it, hang its head on the wall, carve figurines from its tusks, put it on display. Just think what we would do if we found a living mammoth today!

This is where Stephen Baxter begins in **Silverhair**. Silverhair is a young female, her first estrus still ahead. Her Family—the young Bull Lop-Ear, the old Bull Eggtusk, the Matriarch Owlheart, the old Cows Snagtooth and Wolfnose, the young Cow Foxeye, the calf Croptail, the newborn Sunfire—roams an Arctic island all alone. There are no more signs of other Families, and there is an abiding sense of tragedy. Long memory records mammalian origins in the time of Reptiles, a time when the Clans were strong and numerous, a dwindling after the arrival of the fearsome Lost, flight to the island, led by the legendary Longtusk, and a dream of the Sky Steppe, the paradise to which al mammoths go in the end.

Silverhair is wandering when she sees a streak of cloud tipped with a spark o ice. A place of straight lines on the shore. A signboard that identifies a Soviet installation. A strange object, pointed on one end, hollow, staved in by ice and a nest of Lost on the shore. It is no mystery who the Lost are, nor long before disaster strikes. The last mammoths are dead, captured, tormented, and Silverhair struggles to understand, to survive, to save her kin and the fetus now in her womb. She is a noble, intelligent and powerful creature, well deserving of our sympathy, but she has a future only because not all the Lost are villains Baxter is making his tale a trilogy by taking it in an astonishingly sfnal direction about which I will only say that the "Sk Steppe" turns very real.

Baxter has done a nice job of bringing the world of the mammoths to life. H had to do a good deal of speculation but the only real weakness arises when he personifies his beasts. This puts *Silverhair* in the tradition of *Watership Down,* just as the jacket copy claims and it will surely aid appeal to man readers. But a biologist like myself is a obdurate skeptic on such matters.

* * *

Have you taken the plunge yet? Dared to buy a novel available only in electronic form? I've been talking about "digital publishing" for years now, and we seem to be getting closer to viable forms of it. It helps that there are now book-sized, book-heft readers such as the Rocket eBook available, and that vastly more people are on the Internet and getting used to reading on screen.

It also helps that there is some astonishingly excellent material available. As a case in point, consider Chelsea Quinn Yarbro's **Magnificat**, available as a download, on a floppy, or on a CD-ROM (only the CD is not yet available for Macs). It begins in 1997 (necessarily of some other Universe), when the Cardinals of the Roman Catholic Church are voting on a new Pope. Some are already savoring their new privileges and prerogatives, but—a moment of inattention, a tiny dizzy spell, "I hope they can read that scrawl"—and every single Cardinal proves to have written the very same name: Zhuang Renxin. And they all wrote it in Chinese.

Say what?

Somebody must have been playing games, say the Cardinals. Let's try that again.

Same result.

And the rules say that once anyone has been chosen twice—no matter if they're not a Cardinal, not a priest, not a Catholic, not a man—no other Pope may legitimately serve.

So off goes Charles Cardinal Mendosa of Texas to find this Chinese Communist woman, a widow and reputable magistrate. In due time, she agrees that she has a job to do. And when she reaches the Vatican, the cat is well and truly among the songbirds. The Church is long overdue for reform—in the perquisites of the hierarchy and in attitudes toward marriage, divorce, women, and embarrassing documents buried in the Vatican library—and some of those Cardinals are so upset at the new Pope's proposals that they lose no time before plotting her assassination. Also upset are the fundamentalist protestant extremists who see a female Pope as the millennial Antichrist, and her attempts to repair centuries of shortcomings as the proof of the charge.

Fortunately, the Pope has the assistance of some very capable people, including—in the background—a Russian intelligence honcho. She ducks bullet after bullet, but the forces arrayed against her are powerful.

Magnificat is a religious novel, a rant, a tract, a cry for reform of one of the most reactionary organizations on the planet. It is also an excellent read, full of intrigue, and thoroughly thoughtful and thought-provoking. Don't miss it.

Malcolm Willits's **The Wonderful Edison Time Machine** is a children's story for grown-ups with fond memories of a century of popular literature and film (the author runs the Collectors Book Store in Hollywood). Fitting its $65 price, it's a big coffee-table book with loads of jaunty illustrations helping to tell the tale of four kids from Flint, Michigan. They have found an Edison Time Machine squirreled away, and they're going back to save the family fortune from the 1929 Crash. In the process, of course, they encounter Prohibition, flappers, gangsters, and young love, and the reader has a great deal of fun.

The book is self-published, but for a change that does not justify dismissing the product. Production values are as high as they come, and the content will *not* disappoint.

Gene Wolfe remains an SF phenomenon. His fiction is consistently of the highest caliber, and if his tone is sometimes arch or fey, he takes such joy in the act of creation that one cannot help but share it.

Therefore, welcome his new collection, **Strange Travelers**, which begins and ends with an endless traffic jam become refugee camp supplied by slopchoppers and chowchoppers and entertained by people such as Aldo Berry, who plays a chevycap strung with brake cable wire. Trekking the road in search of a new song, Aldo rescues Tim Benson from a beating; Tim plays a muffler turned into a sort of guitar, knows only the old songs full of wist and pain and anger, and—it turns out—is waiting for a certain guide in black.

In between "Bluesberry Jam" and "Ain't You Most Done" lie thirteen more, including such gems as "And When They Appear," in which Christmas ends in perverse horror.

Don't miss this one.

William J. Mitchell, the dean of MIT's School of Architecture and Planning and author of *City of Bits, The Reconfigured Eye*, and *The Logic of Architecture* and co-author of *The Poetics of Gardens* (all published by The MIT Press), suggests in **E-Topia** that the proliferation of silicon into modern life is going to have some profound effects on the nature of the city (among other things). The key is the freeing of many human activities from "place." Already, people work from home, and their employers need not maintain massive offices to house them. People are also shopping from home, and the future may well see the disappearance of retail storefronts from city streets and suburban malls; the businesses will remain, particularly warehousing and shipping, but storefront, inventory, and back office will be unhooked from each other and may reside in very different places. Thus cities will no longer need to have many of the massive buildings that have grown so familiar in the last century or so. Indeed, says Mitchell, the new age will lend itself to a revival of "live/work" neighborhoods, where people both live and work. Many may be part of the info economy, owing their livelihoods to electronic transactions, but they will need dry cleaners, grocers, and restaurants. Those neighborhoods should be charming places, functioning much more on the human scale than we have grown accustomed to. They may even include historic quarters, which can more easily be wired for the Net than they can be redesigned for the "modernity" of past decades.

His argument is often interesting and cogent, but he sometimes falls prey to some of the silicon hype he bemoans. For instance, he insists that bits and bytes are environmentally sound because what's on the screen doesn't use paper. That's true in principle, but the fact is that the modern "paperless office" uses more paper than ever!

Oh, well. Give it time. A futurist doesn't have to be right right away, or in everything he says.

In **Digital Mythologies: The Hidden Complexities of the Internet**, Thomas Valovic is concerned that we have been overcome by "information euphoria," a "curiously contagious sense of enthusiasm for all things digital" that may seem to be harmless but "has been known to impair critical thinking in the sharpest of minds." There is too much hype, he tells us, propagated by a "digital culture" (represented by *Wired* magazine and the works of such SF writers as William Gibson) that exists in comfy symbiosis with corporate interests. The impact of the Internet on society may be quite alarming. On the other hand, "it also might represent a key to unlocking the past and its forgotten knowledge buried under the accretions of sophistication we call civilization and culture" (p. 36).

Mitchell was saying something similar in his book, but he meant more a revival of human-scale communities. Valovic seems to be fond of a 1960s-brand of mysticism or spirituality that the scitech world denies. "Science and technology have overstepped their bounds and become self-sustaining value systems that reach into every nook and cranny of everyday life (p. 185) . . . Unless the proponents of technocracy and digital culture are successful in selling their cleverly recycled scientific materialism, Western science, for all its wonderful contributions, is likely to be replaced as a system of values" (p. 205).

This is the voice of a post-modernist who craves to cling to those outdated mythologies of the human spirit so beloved of Republicans and other traditionalists who, like Leon Kass, think that society should reject cloning because it gives them the willies or, like Valovic, think that Ray Kurzweil's and Hans Moravec's dreams of downloading human minds into computers are a mimic of "the religious quest for 'eternal life' in the absurd technological guise of a bad science-fiction plot" (p. 210).

Science and technology deal with the world as it is—Is it true? Does it work?—not the world as people would like it to be. They may be pressed into the service of human wishes (as when the Green Revolution was summoned to support population growth), but if those wishes are not consistent with the world as it is (carrying capacity), that service must be short-lived. We must adjust our technologies to meet human needs, say Valovic and many other critics of modern science and technology, but the historical truth is that when science and technology show us something new about the way the world works, we adjust our beliefs (despite the grumblings of traditionalists). Technologies that do not meet (or stop meeting) human needs or do not illuminate the world and our place in it do not last. Zyklon-B and human sacrifice are gone. So are trans-Atlantic passenger ships and phrenology and orgone. So, says Mitchell, will soon be the great urban office building. ▪

New opinions are always suspected, and usually opposed, without any other reason but because they are not already common.

— John Locke

Habit creates the appearance of justice; progress has no greater enemy than habit

— José Martí

Dear Stan,

I would like to applaud the current *Analog* editorial choices.

I've been reading *Analog* from the1960s, and have enjoyed it immensely over the years.

The February issue letters to the editor (Ezra Dweck) mentioned microfilm sets and reminded me that one of the serialized stories that I never finished in the early 1960s was entitled the "Scarlet Saint." Might I recover it from the microfilms set, if those are still available from someone? I would appreciate an address, or whatever, to reach the microfilm source.

The problems about publication rights I understand.

By any chance are the Analog tables of contents indexed for search, perhaps accessible on the Web?

Hal Gale

The microfiche sets are unfortunately no longer available, but our website does contain a searchable index going at least back to the early 1980's (and, by the time you read this, maybe farther).

[For more information on microfiche, see the letter from John Zube later in Brass Tacks.]

Mr. Stanley Schmidt

For shame, memes, really. What about marketing? Talking about "something" doesn't make it so, and doesn't make it a thing, unless you make the cognitive mistake of reification.

Memes do not have an existence independent of the minds containing them. Hence the correct term is ideas; in fact, you actually use that word. Also the way you describe the behavior memes induce is just as easily described by one of the various forms of conditioning the old time psychologists used to talk about.

And as for violence and all the rest, memes really! Isn't there a line or two in the bible (now there's a hoary source), about as a man thinketh in his heart so he is?

In short, I think your using made up words to describe ideas and processes already well understood and named is only a poor attempt to get some marketing differentiation into your "information product."

I would suggest that in your terms, the word "meme" is as you use it in fact a meme of confusion.

Ken Strang,
Vancouver BC

"A poor attempt to get . . . marketing differentiation"? Hardly! Rather an attempt to construct a useful model to help think productively about certain things. (Maybe you should read what Dawkins and Henson wrote about it. . . .) Even if other models are also usable, that does not rule out the possibility that a new one might be more useful under at least some circumstances. The Ptolemaic universe was a useful model, too, but its elaborate system of epicycles and eccentrics made it so clunky that the Copernican version would have been an improvement

even if more accurate observations hadn't made it necessary.

Stanley:

I've been reading Analog for almost 40 years; the first story I ever read was Ben Bova's "The Dueling Machine"; now we have VR; another early 60's gem was John Berryman's "The Trouble With Telstar"—and I saw them fix the Hubble. Personally, my graphics career started with lead-set type, wax, and stat cameras; now I have a PC with thousands of fonts and video capture and stereo sound.

Reality has been just as Astounding as the fiction.

Ed Stockelbach

Dr. Schmidt,

I find it rather exciting that the SF community—including members so prominent as Ben Bova—are beginning to seriously look at aging research, because I was raised hearing about all the new developments in the field, and have always felt that the social changes resulting from vastly extending the typical lifespan would be a good subject for science fiction. My father (who introduced me to *Analog*, and SF more generally) is a prominent researcher in gerontological endocrinology. His research team just last year finished the broadest study to date on human growth hormone. Should Mr. Bova be interested in finding out more about this, the papers (which were presented at the national Endocrine Conference) will carry the names Harman and Blackman, and I'm sure my dad would be more than happy to fill in any details.

R. Michael Harman

Dear Mr. Stanley Schmidt,

When was the last time that you mentioned in *Analog* the availability of back issues of *Astounding* and *Analog*, on roll film or microfiche from University Microfilms, Bell & Howell and, at least for a time, also from MIC: Micro Information Concepts?

The latter has gone bankrupt, as far as I know—but there should be a successor to handle its stock, although I do not know who it is. Whether their issues paid attention to the copyrights laws or not I do not know—nor care greatly.

I refrained from purchasing their products because I knew that with all these issues in my possession I would not get much other work done for a long period.

My own shoe-string libertarian microfiche enterprise offers only the *Analog/Astounding* Index by Ashley & Jeeves, with their permission, 264pp, 36x reduced, back in Peace Plans No. 413, still only at US$1. (However, for the order of a single microfiche I would have to levy a surcharge for handling and postage, the latter coming here now to a minimum of A$1.40, i.e., US $2, total:$3. For orders of at least 10 LMP microfiche I do not charge for handling and postage.)

John Zube

Dear Dr. Schmidt:

I recently read your editorial comments in the February 2000 Analog.

When I critically examine your suggestion of encouraging "good" memes to help drive out the "bad" ones, I find it inconsistent with the "memes as diseases" analogy. The idea of evangelizing good ideas to prevent bad ones is roughly equivalent to spreading good germs to prevent bad ones. Not entirely ridiculous, we have had some success controlling dangerous diseases with inoculations. But for the analogy to hold, it's not good memes that need to be spread around, but weak strains of bad ones. In principle, weak memes should help us build our defenses against more powerful versions of the meme.

Does the analogy hold? Well, you mentioned that back in 1969 Nazism was introduced to high school children. Presumably, they had already been exposed to the meme "all men are created equal" and other U.S. values. Apparently those good memes didn't stop it from spreading like wildfire. But did it spread to their parents? Unlike their children, they had already been exposed to a variant of the Nazism meme.

Teaching critical thinking is a step in the right direction, but people also need hands on, practical experience applying critical thinking in the rejection of memes. Part of the reason dangerous memes are dangerous, is because they can push aside good memes. Instead of destroying them, perhaps we should keep track of dangerous memes, and try to develop vaccines for the really dangerous ones.

Scott Nelson
scott@helsbreth.org

No analogy is perfect (as I explicitly acknowledged in the editorial); if it were, it would be called an identity. But it can still be a useful tool for thinking.

Dear Mr. Schmidt:

I found February's editorial a bit disturbing because of several rather extraneous comments you included.

First, on the subject of violent games, you say you have "no respect for those who create them." I am not sure the wage slaves who do the art work and programming of video games, violent or otherwise, loose much sleep over your respect. I object to both atomic weapons and the pyramids of Egypt, but my disdain is for those caused them to be built not the people who did the work. Since games pay the bills and create a need for processor speed, I would bet they are a major spur to the advancement of the personal computer.

Second, on the subject of the Internet, you say "It has been well established . . . . as an extraordinary breeding ground for the creation, mutation, and dissemination of meres. . . ." Where has this been well established? What scientific study even suggests this?

Except for the fact that the Internet distributes more old pornographic pictures without requiring paper and sponsors more lewd typing lessons in sex oriented chat rooms than people would ever tolerate without the sex, it is hard to see much to the Internet other than advertising.

Third, you referred to the concept of "teaching critical thinking." This seems to be a nice and well spread current buzz phrase, but what does it mean? Is it a course in logic? Mr. Spock's pure logic served him well only when dealing with inanimate objects not people. Or is it merely teaching the pupil to dislike what the teacher dislikes. If it is this, then it is not much different from the "South Pacific " song about being taught to hate the people your relatives hate.

Fourth, you say "A single mind. . . . functioning rationally cannot. . . accommodate mutually contradictory beliefs." In the imaginary universe of robots or perfectly rational human beings this might be so, but that is not reality. Humans are not completely rational so very frequently they maintain full fervor in contradictory beliefs. For instance, Jefferson wrote that all men were created equal and never freed his slaves. Most Christians are against the worship of idols yet many of them will kneel before a statue of a saint and pray to that saint. If you watch PBS documentaries long enough, you will see them praise people of genius specifically for the "talent of holding mutually contradictory ideas."

None of this has much to do with memes or their transmission except that you accept as established fact several ideas (memes) that I find highly questionable.

By the way, despite your reiteration of dating the concept of memes to R. Dawkins in 1976, I discussed identical ideas (I did not invent them) in an undergraduate Anthropology seminar about evolution at Penn State in 1961. My professor called them "The grandiose sort of theory that undergrads frequently waste their time on."

While my "critical thinking" would still disagree with that statement, the professor continued to teach (spreading memes) at Penn State until his retirement; and I was diverted out of the field by the draft for the Viet Nam war. Funny how evolution works sometimes, is it not?

Gary L. Mootz

First, I never imagined that the "wage slaves" would lose sleep over my respect or lack thereof, but I find it intriguing that you absolve them of all responsibility for their actions (even if they were in fact all "wage slaves," which I seriously doubt). Your argument seems to imply that anything anyone does is all right as long as someone else employs them to do it. I seem to recall similar arguments from the defense in the Nurnberg trials, and respectfully submit that for people of principle, some jobs are unacceptable at any price—and there are almost always other ways to survive.

Second, do you really think a formal scientific study is needed before a reasonably confident statement can be made that anything is true? Would you not believe that the Sun rises at approximately 24-hour intervals if no Serious Scientific Study had been done to prove it? Your cart is before your horse; often scientific studies are done because something has been pretty well established by simple empirical observation.

Yes, teaching critical thinking involves logic, among other things. I assume your suggestion that it means "teaching the pupil to dislike what the teacher dislikes" is facetious, so I'll say no more about it.

Fourth, to the extent that a mind holds contradictory beliefs, it is not functioning rationally. But then, as you yourself say, humans are not completely rational, so we don't really disagree, at least on this one!

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A. E. VAN VOGT, 1912-2000

Alfred Elton van Vogt, preeminent "Golden Age" writer who strongly preferred to be known by his initials or "Van," died January 26, 2000, of complications from pneumonia. He had also suffered for several years from Alzheimer's disease.

Born in Manitoba, Canada, on April 26, 1912, Van married fellow writer E. Mayne Hull in 1939.[1] They moved to the United States in 1944, and Van became a naturalized U.S. citizen and spent the last fifty years of his life in Los Angeles, California.

His science fiction career began with a bang, with the publication of the novelette "Black Destroyer" in this magazine (then called *Astounding*) in 1939. He quickly became one of the magazine's (and the field's) most prolific and popular contributors, particularly renowned for intricately plotted space opera of sweeping scope, often featuring superhuman heroes, including *Slan*, *World of Null-A* (and its sequels), and *The Weapon Shops of Isher*. Despite a long period of relative inactivity following his very productive initial decade, and hostility from some critics, his influence and importance to the field were recognized by a Casper Award for Lifetime Achievement (1980) and a Grand Master Nebula Award (1996), and he was one of the four inaugural inductees into the Science Fiction and Fantasy Hall of Fame established by the University of Kansas Center for the Study of Science Fiction.

He is survived by his second wife, Lydia,[1] who suggests that donations in his memory be made to the Alzheimer's Association, 5900 Wilshire Blvd., Suite 1700, Los Angeles, CA 90036.

-Stanley Schmidt-

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[1] E. Mayne Hull died in 1975.

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UPCOMING EVENTS Anthony Lewis

1–4 July 2000
CONOLULU/WESTERCON 53 (Western North America SF conference) at Sheraton Waikiki, Honolulu HI. Guest of Honor: Dan Simmons, Artist Guest of Honor: Ctein, Fan Guest of Honor: John Lorentz. Locus Awards presented. Registration: $45 attending; $25 supporting. Info: Conolulu, 42 Aekai Place, Lahaina HI 96761; e-mail: tropo@maui.net; URL: www.maui.net/~tropo

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21-23 July 2000
READERCON 12 (literary-oriented SF conference) at Marriott, Burlington Mass.; Guest of Honor: Michael Moorcock. Registration: $35 until 7 July 2000 $45 at door. Info: Readercon, Box 38-1246, Cambridge MA 02238; e-mail: info@readercon.org; URL: www.readercon.org

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30 July–1 August 2000
RIVERCON XXV (Kenticky area SF conference) at Executive West Hotel, Louisville, Ky. The is the last RiverCon. Guests include : Larry Niven, George R.R. Martin, Esther M. Friesner, Allen Steele. TM: Mike Resnick. Registration: $35. Info: RiverCon, Box 58009, Louisville KY 40268; e-mail: RiverConSF@aol.con; URL: http://members.aol.com/rivercon

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18–20 August 2000
ARMADILLOCON 22 (Austin area SF conference) at Omni Southpark, Austin Tex. Guest of Honor: Catherine Asaro; Artist Guest of Honor: Adam "Mojo" Lebowitz; Editor Guest of Honor: Betsy Mitchell; TM: Mary Doria Russell; Fan Guest of Honor: Robert Taylor. Registration: $20. Info: ArmadilloCon, Box 27277, Austin TX 78755.

25–27 August 2000
BUBONICON 32 (Albuquerque area SF conference) at Albuquerque, N.M. Guest of Honor: Walter Jon Williams; Artist Guest of Honor: Lela Dowling. Registration: $20 until 14 February 2000, probably more later. payable to NMSF Conference. Info: NMSF Conference; Box 37257, Albuquerque NM 87176; phone: +1.505.266.8905; e-mail: cwcraig@nmia.com

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31 August–4 September 2000
CHICON 2000 (58th World Scienc Fiction Convention) at Hyatt Regency Chicago, Ill. Guests of Honor—Ben Bov (former editor of Analog), Bob Eggleton Jim Baen, Bob & Ann Passovoy, TM—Harry Turtledove. Registration—$150 supporting $40. [These rates are good a of 1 October 1999; they may go up again These are the latest rates posted on the Internet as of the time this column wen to press.] This is the SF universe's annua get-together. Professionals and reader from all over the world will be in attendance. Talks, panels, films, fancy dres competition—the works. Info: Chico 2000, Box 642057, Chicago, IL 60664 email: info@chicon.org URL http://www.chicon.org/

26–29 October 2000
WORLD FANTASY CONVENTION 26 a Omni Bayfront, Corpus Christi, Tex. Guest of Honor—K. W. Jeter, John Crowley; TM—Joe Lansdale. Registration—$90 until 1 November 1999, then more. Info: WFC 200 Box 27277, Austin, TX 78755 +1.512.835.9304 (voice), +1.512.835.763 (fax), email: fduartejr@aol.co URL:http://2000.worldfantasy.org ■

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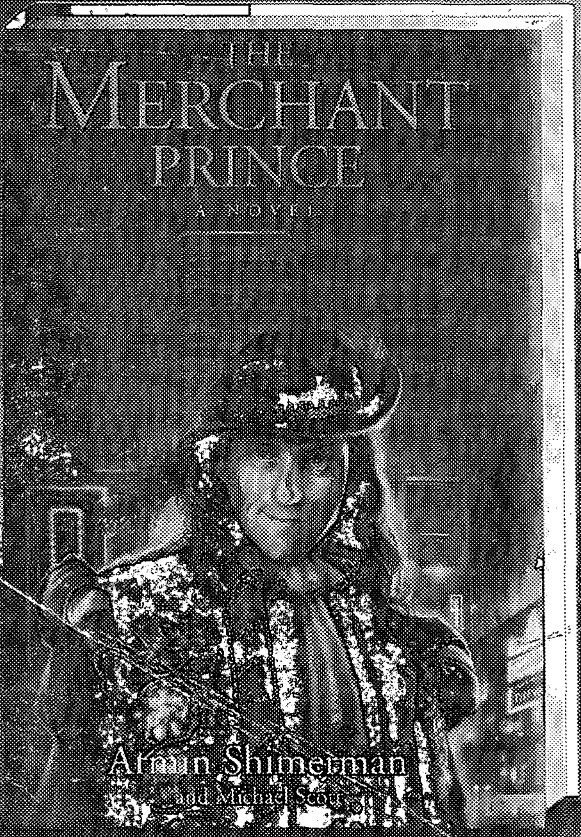

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